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ABSTRACT

A survey of 470 graduates of the six engineering technology programs at Wake Technical Institute--Architectural, Chemical, Civil Engineering, Computer, Electronic Engineering, and Industrial Engineering Technologies--and 227 of their employers was conducted in October, 1979, to determine the science and mathematics topics most needed by engineering technicians. The survey instrument, developed by two juror groups and subjected to a stability-reliability test, contained 81 items under 17 topics and an open-ended question. The 17 topical areas were mechanics, fundamentals of electricity/electronics, light, sound, heat, modern physics, chemistry, biology, geology, data processing, algebra, trigonometry, logarithms, geometry, analytical geometry, calculus, and statistics. The survey revealed that: (1) mathematics topics were important to all graduates; (2) various science topics were needed for different technology areas; (3) knowledge of a computer language was important to all but architectural technicians; and (4) science and mathematics topics were more important to graduates than to employers. A sample questionnaire and over 100 tables are appended. (JP)

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ED178137

A STUDY TO DETERMINE THE BASIC SCIENCE AND MATHEMATICS TOPICS MOST NEEDED BY ENGINEERING TECHNOLOGY GRADUATES OF WAKE TECHNICAL INSTITUTE IN PERFORMING JOB DUTIES

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JC 790 610

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A STUDY TO DETERMINE THE BASIC SCIENCE AND MATHEMATICS TOPICS MOST NEEDED BY ENGINEERING TECHNOLOGY GRADUATES OF WAKE TECHNICAL INSTITUTE IN PERFORMING JOB DUTIES

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Wake Technical Institute
Raleigh, North Carolina
1979

SUMMARY

The major purposes of this study were to determine the attitudes of the graduates of Wake Technical Institute's 6 Engineering Technology Programs and the employers of these graduates concerning the basic science and mathematics topics most needed by engineering technicians in performing their duties. Another purpose of this study was to obtain comments from respondents concerning topics other than those listed on the survey which are needed by engineering technicians in performing their duties.

A questionnaire to determine the basic science and mathematics topics most needed by engineering technicians in performing their duties was developed and mailed to 697 participants. Of this total, 470 were graduates of one of the 6 Engineering Technology programs at Wake Technical Institute who received degrees during the period from 1969 through 1977 and 227 were employers of Wake Technical Institute graduates of these programs.

Responses to the questionnaire, which consisted of 81 items under 17 basic science and mathematics topics and one open-ended statement, were analyzed. Conclusions were based on an analysis of the frequency of graduates' and employers' responses by response category for the 6 Engineering Technology fields. Also a Chi Square analysis was used to test 6 null hypotheses to determine whether significant differences in responses existed between graduates and employers from each field. Responses to the open-ended statements were analyzed and the information summarized by responding group.

Among the major conclusions derived from the findings were the following:

1. Graduates and employers in all 6 Engineering Technology fields indicated that a knowledge of mathematical topics ranging from Algebra to Calculus was important for an engineering technician.

The extent to which a certain mathematical topic was important depended on its direct usefulness in solving day-to-day problems on the job. Support for the study of other mathematical topics resulted from a need for a foundation in mathematics which would afford the technician an opportunity to keep abreast of technological changes as well as to develop analytical skills.

2. The participants believed that an engineering technician needed a knowledge of basic science topics which would provide a foundation for the application of the skills and knowledge in their particular field. For example, chemical technicians indicated support for a study of the basic science of chemistry. Electronic technicians, on the other hand, indicated an interest in the fundamentals of electricity and electronics which explain the electrical phenomena associated with the applications of electronics and electricity.

3. For the topic DATA PROCESSING, all study participants except those in Architectural Technology believed that knowledge of at least one specific programming language was important. In addition, respondents indicated an interest in the study of COBOL.

4. Based on the response patterns of employers and graduates, graduates' responses were more supportive of a knowledge of basic science and mathematics topics. Employers, on the other hand, tended to support only those topics which were immediately useful in solving day-to-day problems. This difference in response patterns can be attributed to the engineering technicians' desire to stay abreast of technological change while employers appear primarily interested in the knowledge and skills which contribute to immediate production.

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INTRODUCTION

Wake Technical Institute was chartered on April 3, 1958, as the Wake County Industrial Education Center. On January 8, 1964, the Center was transferred from the Wake County Board of Education to the Board of Trustees, and the name was changed to W. W. Holding Industrial Education Center. On March 3, 1966, the Industrial Education Center was approved as a technical institute by the State Board of Education and licensed to award the Associate in Applied Science Degree. The name was changed to Wake Technical Institute in 1974.

The Engineering Technology unit was established during the 1964-65 academic year when 15 students were admitted to the Civil Engineering Technology program in September, 1964. In September, 1965, 35 first-year Civil Engineering students were admitted; however, no additional programs were added to the Engineering Technology unit until the start of the 1967-68 academic year.

The Architectural Technology, Electronics Engineering Technology, and Chemical Technology programs were begun in the fall of 1967, bringing to 4 the number of programs in Engineering Technology at that time. The following academic year, 1968-69, Industrial Engineering Technology was added. The Engineering Technology unit became complete in the fall of 1969 when Computer Technology was added. No programs have been added to the unit since 1969, and the period since has been marked by efforts to refine the existing engineering technology offerings.

Though the unit has not added new programs since 1969, significant growth has occurred in terms of instructional personnel and students enrolled. During the fall of 1969, the Engineering Technology unit had 9 full-time instructors, and 175 students were enrolled in the 6 programs.

During the past academic year, 15 full-time instructors were employed in the unit. At the close of the 1977-78 fall quarter, 230 students were enrolled in Engineering Technology programs.

From a staff of one civil engineer and 15 students in 1964, the Engineering Technology unit has grown to include 6 associate degree programs and over 200 students in 1977-78. Enrollment is shown in Table 1.

TABLE 1 - Engineering Technology Enrollment

Winter Quarter, 1977-78

Curriculum	First-Year	Second-Year	Total
Architectural Technology	36	17	53
Chemical Technology	0	10	10
Civil Engineering Technology	28	19	47
Electronics Engineering Technology	27	25	52
Computer Technology	10	13	23
Industrial Engineering Technology	8	15	23
TOTALS	109	99	208

Problem Area

Each of the 6 two-year Engineering Technology curriculums consists of approximately 25 percent basic science and mathematics. The objectives of the basic science and mathematics sequence are (American Society for Engineering Education, 1962 and 1972; Engineers' Council for Professional Development, 1977):

> Mathematics - The student will develop an understanding of the basic mathematical concepts and an ability to apply these concepts in solving problems related to technology. The mathematics

instruction should be of college level and begin with college algebra and include basic calculus.

Physics - The student will develop an understanding of the basic concepts which are the foundation of all technologies. Emphasis should be placed on the understanding, measurement and quantitative expression of the physical phenomena. Students should acquire the ability to carefully work, precisely observe, and accurately measure and record data in laboratory exercises related to the basic physical concepts.

Approximately two-thirds or 150 Engineering Technology students take one or more of the basic science and mathematics courses each quarter.

Although the present basic science and mathematics courses meet quantitatively and qualitatively the criteria of the accrediting agency (ECPD), the following trends over the past 3 years indicate uncertainty as to the relevance of the topics covered in the sequence:

1. High drop out and failure rate in physics,
2. Trends among the Engineering Technology faculty to press for reduction of basic science and mathematics courses in Engineering Technology curriculums,
3. Disagreement among Engineering Technology faculty as to the importance of various topics covered in the basic science and mathematics sequence.

Given the limitation of time imposed on a two-year curriculum, irrelevant subject matter which does not contribute toward preparing students for entry into occupations as science and engineering technicians should be omitted. Therefore, identifying scientific and mathematical topics is critical to insure that graduates (1) can perform effectively as technicians and (2) do not become technically obsolete.

The Engineering Technology faculty, although acquainted with the broad spectrum of scientific and mathematical topics which could be included in a basic science and mathematics sequence, are in need of feedback from the employers and graduates.

Purpose of the Study

The purposes of this study were to determine the attitudes of the graduates of Wake Technical Institute's six Engineering Technology programs and the employers of these graduates concerning the basic science and mathematics topics most needed by engineering technicians in performing their duties. Another purpose of this study was to obtain comments from respondents concerning topics other than those listed on the survey which are needed by engineering technicians in performing their duties.

Hypotheses

In order to meet the objectives of the study, 6 null hypotheses were tested for each of 80 items on an attitude questionnaire. A null hypothesis was rejected when observed differences between groups of graduates and employers would have been expected to have occurred, by chance, fewer than 5 times in 100 similar samples.

Data were analyzed to test the null hypotheses that there were no significant differences in attitudes as measured by the survey between:

(1) Graduates of the Architectural Technology program at Wake Technical Institute and employers of these graduates,

(2) Graduates of the Chemical Technology program at Wake Technical Institute and employers of these graduates,

(3) Graduates of the Civil Engineering Technology program at Wake Technical Institute and employers of these graduates,

(4) Graduates of the Computer Technology program at Wake Technical Institute and employers of these graduates,

(5) Graduates of the Electronics Engineering Technology program at Wake Technical Institute and employers of these graduates, and

(6) Graduates of the Industrial Engineering Technology program at Wake Technical Institute and the employers of these graduates.

Limitations of the Study

This investigation was limited to the study of attitudes of graduates of Wake Technical Institute's six Engineering Technology programs and the employers of these graduates concerning the basic science and mathematics topics most needed by engineering technicians in performing their duties. A questionnaire was mailed during the fall of 1978 to all graduates of the six Engineering Technology programs at Wake Technical Institute who had graduates during the period from 1969 to 1977. The same questionnaire was simultaneously mailed to employers of Engineering Technology graduates from Wake Technical Institute as determined from the Institute's student follow-up records and the records of the Cooperative Education Office.

Participants in the study responded to a questionnaire consisting of a total of 81 items grouped under 17 major topics. One item, however, asked respondents to indicate the computer programming language they viewed as necessary for engineering technicians in performing their duties. This item was omitted in the statistical analysis. The remaining 80 items were used to provide data for measuring the differences between the categories of respondents.

The statistical analysis was based on the 80 items. In addition, the participants were asked to record on the questionnaire those basic science and mathematics topics which are needed by engineering technicians in performing their duties, but which were not listed on the survey.

Because of the magnitude of the study and the large amount of data collected, comparisons among various types of Engineering Technology graduates or among various types of employers were not made.

PROCEDURES

The purpose of this chapter is to present the procedures followed to establish the populations of Engineering Technology graduates and the employers of these graduates to whom the questionnaire was sent, the procedures followed to develop the survey instrument, a report of the reliability study, and the procedures used to analyze the data obtained from the survey.

The Sample

The survey questionnaire was administered to a total of 697 participants. Of this total, 470 had graduated from one of Wake Technical Institute's six Engineering Technology programs between and including 1969 and 1977. The remaining 227 participants were employers of Engineering Technology graduates from Wake Technical Institute as determined from the Institute's student follow-up records and records from the Institute's Cooperative Education Office.

The groups selected for participation in the study included (1) graduates of one of 6 Wake Technical Institute's Engineering Technology programs now employed as engineering technicians, and (2) supervisory employers of these graduates.

Each participant was requested to indicate whether the topic listed was essential knowledge, desirable knowledge, or knowledge not needed in performing job duties of an engineering technician in a particular field. At the end of the questionnaire, participants were asked to record topics not appearing in the 81 items which they considered to be needed by engineering technicians in performing their job duties.

Development of Instrument

In developing the items on the attitude questionnaire, topics which are currently taught in the basic science and mathematics courses in the six Engineering Technology programs at Wake Technical Institute were identified. In addition, other topics which have historically been a part of Engineering or Engineering Technology-type programs or which appear to be necessary due to advances in technology were identified. These topics encompassed both basic physical and natural sciences as well as mathematics.

A list of basic science and mathematics topics was submitted for evaluation to a faculty committee comprised of department heads from the Architectural Technology, Chemical Technology, Civil Engineering Technology, Computer Technology, Electronic Engineering Technology, and Industrial Engineering Technology departments and an instructor from the Mathematics and Physics Department. On the basis of the recommendations from this committee, 80 items under 17 major topics were identified as representative of the basic science and mathematics topics necessary to perform job duties of an engineering technician in at least one of the following fields: Architectural Technology, Chemical Technology, Civil Engineering Technology, Computer Technology, Electronics Engineering Technology, Industrial Engineering Technology.

Based on their present involvement with two and four-year Engineering Technology programs, nine individuals were selected as jurors for the purposes of reviewing, evaluating, and editing the 80 items chosen by the faculty committee. The names and current positions of the jurors are as follows:

1. Dr. James D. Forman
Director, School of Applied Science
Rochester Institute of Technology
Rochester, New York

2. Mr. Frank A Gourley, Jr.
Assistant Director
Engineering Technology Programs
N. C. Department of Community Colleges
Raleigh, North Carolina

3. Mr. Robert A. Hahn
Instructor, Building Construction Technology
Wilkes Community College
Wilkesboro, North Carolina

4. Dr. Joseph T. Nerden
Professor Emeritus
Industrial and Technical Education
North Carolina State University
Raleigh, North Carolina

5. Mr. Kenneth S. Oleson
Director, Occupational Education Programs
North Carolina State Board of Education
Raleigh, North Carolina

6. Dr. Walter E. Thomas
Dean, Technology and Applied Science
Western Carolina University
Cullowhee, North Carolina

7. Dr. Richard J. Ungrodt
Vice-President for Academic Affairs
Milwaukee School of Engineering
Milwaukee, Wisconsin

8. Dr. Edward M. Willis
Acting Chairman, Department of Engineering Technology
The University of North Carolina at Charlotte
Charlotte, North Carolina

9. Dr. Lawrence J. Wolf
Head, Manufacturing Technology
Purdue University
Calumet Campus
Hammond, Indiana

Each juror was mailed a copy of the questionnaire, an instruction sheet for graduates and an instruction sheet for employers for review and comment.

In general, the jurors indicated that this questionnaire survey was a valid procedure for identifying the basic science and mathematics topics most needed by engineering technicians in performing their duties. Recommendations for improvement included the division of one item into two separate items, revision of the method of recording the respondent's field and simplification of recording responses.

The final form of the questionnaire included 81 items under 17 topics and one open-ended statement. This instrument was administered to a population comprised of employers of Wake Technical Institute's Engineering Technology graduates and graduates who completed one of Wake Technical Institute's 6 Engineering Technology programs from 1969 to 1977.

Upon completion of the development of the survey questionnaire, 697 forms were mailed in October of 1978 to the members of the population. Attached to the questionnaire was a cover letter from the Director of Institutional Planning and Research, Wake Technical Institute, explaining the purpose of the study.

Reliability of the Survey Questionnaire

Three types of reliability, stability, equivalence, and internal consistency, were considered in developing the survey questionnaire (Sax, 1968). Since only one questionnaire form was developed, an equivalence reliability study was eliminated. Also, the diversity of the items on the questionnaire was not conducive to an internal consistency reliability evaluation. A stability reliability study was conducted on the initial questionnaire.

Stability, often referred to as test-retest reliability, measures the correlation between scores of a group when the same test is given on two different occasions. Test-retest reliability, or the coefficient of stability, is influenced by such factors as memory, familiarity, and length of time between test and retest.

The reliability of the survey questionnaire was determined by administering the form to 3 different groups of second-year Engineering Technology students in the last quarter of either the Civil Engineering Technology, Architectural Technology or Electronic Engineering Technology program. After a two-week interval, a second administration of the form to these students was conducted. A total of 25 test-retest forms was used in the reliability calculations. The student responses to the questionnaire were not included in the analysis of the data.

Since the items of the questionnaire dealt with such different and diverse topics, each item was treated as an individual test. The Spearman correlation formula (Snedecor and Cochran, 1967) was used to determine the correlation coefficient between the mean score for a given item on the test and the same item on the retest. Seventy-nine correlation coefficients were calculated for 79 items on the questionnaire.

One item requested respondents to complete a blank with additional topics. This item was omitted in the reliability calculations. The results of the reliability study appear in Table 2.

Respondents to item H.5., ZOOLOGY (ANIMAL BIOLOGY), exhibited the highest degree of stability in their attitudes toward this topic as indicated by a correlation coefficient of 1.0. Respondents' attitudes were least stable toward ARITHMETIC AND GEOMETRIC PROGRESSIONS (items K.13.) as indicated by a correlation coefficient of 0.46.

In summary, 18 out of the 79 items or 23 percent had correlation coefficients between 0.90 and 1.0, 34 items or 43 percent had coefficients between 0.89 and 0.80, 23 items or 29 percent had coefficients between 0.79 and 0.70, and only four items had coefficients less than 0.70.

Table 2 - Item Correlation Coefficients For Test-Retest

Item Number on Form	A.1.	A.2.	A.3.	A.4.	A.5.	B.1.	B.2.
Correlation Coefficient	.82	.78	.80	.92	.82	.88	.88

Item Number on Form	B.3.	B.4.	B.5.	B.6.	B.7.	C.1.	C.2.
Correlation Coefficient	.92	.88	.92	.88	.94	.78	.68

Item Number on Form	C.3.	C.4.	D.1.	D.2.	E.1.	E.2.	E.3.
Correlation Coefficient	.86	.84	.84	.84	.74	.88	.76

Item Number on Form	F.1.	F.2.	F.3.	G.1.	G.2.	G.3.	G.4.
Correlation Coefficient	.80	.76	.78	.82	.96	.96	.88

Item Number on Form	G.5.	H.1.	H.2.	H.3.	H.4.	H.5.	H.6.
Correlation Coefficient	.92	.94	.90	.92	.96	1.0	.98

Item Number on Form	I.1.	I.2.	I.3.	I.4.	I.5.	J.1.	J.2.
Correlation Coefficient	.88	.72	.78	.80	.88	.76	.80

Item Number on Form	K.1.	K.2.	K.3.	K.4.	K.5.	K.6.	K.7.
Correlation Coefficient	.88	.82	.78	.90	.78	.80	.82

Item Number on Form	K.8.	K.9.	K.10	K.11.	K.12.	K.13.	K.14
Correlation Coefficient	.72	.78	.76	.76	.76	.46	.70

Table 2 - Item Correlation Coefficients for Test-Retest

Item Number on Form	L.1.	L.2.	L.3.	L.4.	L.5.	L.6.	M.1.
Correlation Coefficient	.92	.80	.88	.72	.88	.70	.90

Item Number on Form	M.2.	N.1.	N.2.	O.1.	O.2.	O.3.	O.4.
Correlation Coefficient	.88	.86	.86	.94	.94	.82	.86

Item Number on Form	P.1.	P.2.	P.3.	P.4.	Q.1.	Q.2.	Q.3.
Correlation Coefficient	.70	.70	.82	.82	.80	.68	.74

Item Number on Form	Q.4.	Q.5.
Correlation Coefficient	.68	.74

Analysis of Data

Due to the diverse topics covered in the questionnaire, each item was treated individually in order to obtain valid information. The following procedures were used in the analysis of the data:

1. Percentages of responses for each response category - ESSENTIAL, DESIRABLE, NOT NEEDED - by each type of respondents - graduates from one of the six Engineering Technology programs at Wake Technical Institute and employers of graduates from one of these programs - were analyzed to determine the basic science and mathematics topics most needed by engineering technicians in performing job duties. To facilitate the reporting of the results, responses for each of the 80 items were grouped under one of the 17 major topics and the responses of graduates, employers and the combined groups of gradutes and employers by Engineering Technology were compared for each of the 17 major topics.

2. A Chi Square analysis was used to test the 6 null hypotheses to determine whether or not significant differences in responses existed between graduates and employers of graduates from one of the 6 engineering technology programs. In the Chi Square analysis, the null hypothesis of no significant difference was rejected when observed differences between graduates and employers of the graduates of a given program would have been expected to occur by chance fewer than 5 times in 100 similar samples.

3. The open-ended statement was analyzed and the information summarized by responding groups.

RESULTS AND DISCUSSION

In this chapter the results of the analyses of the data are presented and discussed. Included in this section are the null hypotheses and the returns on the populations. In the next section, a summary of the Chi Square analysis is presented. In sections three through nine, the responses of graduates and employers are discussed by engineering technician field. The analysis of each field is based upon the items grouped under the 17 major topics. An analysis of the responses to the open-ended statement on the questionnaire is presented in the last section of this chapter.

In order to meet the objectives of the study, 6 null hypotheses were tested for each of 80 items on the questionnaire. A null hypothesis was rejected when observed differences between groups would have been expected to have occurred by chance fewer than 5 times in 100 similar samples.

Data were analyzed to test the null hypotheses that there were no significant differences in attitudes as measured by the survey questionnaire between:

(1) Graduates of the Architectural Technology program at Wake Technical Institute and employers of these graduates,

(2) Graduates of the Chemical Technology program at Wake Technical Institute and employers of these graduates,

(3) Graduates of the Civil Engineering Technology program at Wake Technical Institute and employers of these graduates,

(4) Graduates of the Computer Technology program at Wake Technical Institute and employers of these graduates,

(5) Graduates of the Electronic Engineering Technology program at Wake Technical Institute and employers of these graduates, and

(6) Graduates of the Industrial Engineering Technology program at Wake Technical Institute and the employers of these graduates.

The questionnaire was administered to a total of 697 participants in October of 1978; 470 were graduates of one of the 6 Engineering Technology programs at Wake Technical Institute who received degrees during the period from 1969 through 1977 and 227 were employers of Wake Technical Institute graduates of these programs. Of the total surveyed, 170 responses, or 24 percent of the total mailed, were returned in usable form. Of the 470 student questionnaires, 23 percent were completed and returned. However, 147 questionnaires or 32 percent of the total graduate questionnaires mailed out were returned as non-deliverable. Twenty-nine percent of the employers responded while 67 percent failed to respond. Only 4 percent were returned as non-deliverable.

A copy of the questionnaire is provided in Appendix A. Both employers and graduates received the same questionnaire; however, employers' forms were printed on yellow paper and graduates' on white paper. Table 3 gives a summary of the number of questionnaires mailed to graduates and employers by Engineering Technology field, the number returned by Engineering Technology field, and the percentages of responses for the total population and for each Engineering Technology field. In Table 3 no attempt was made to classify employers by technology in the sample; however, employers who responded were grouped by technology.

Table 3 - Number Of Employers And Graduates By Technology Participating In The Study

Respondents	Sample Size	Number of Responses	Percentage of Responses
Architectural			
Employers		14	
Graduates	96	16	17%
Chemical			
Employers		3	
Graduates	28	6	22%
Civil			
Employers		25	
Graduates	191	52	27%
Computer			
Employers		10	
Graduates	33	10	30%
Electronics			
Employers		11	
Graduates	92	20	22%
Industrial			
Employers		3	
Graduates	30	4	13%
TOTAL			
Employers	227	66	29%
Graduates	470	108	23%

Chi Square Analysis

A Chi Square analysis was used to test the 6 null hypotheses to determine whether or not there were significant differences in responses between employers and graduates for each engineering technology on each of the 80 items in the questionnaire. This statistical procedure was used to determine whether the observed differences would have occurred by chance alone. In the Chi Square analysis the null hypothesis was rejected when observed differences between employers and graduates occurred by chance fewer than 5 times in 100 similar samples.

Table 4 presents a summary of differences by probability level for the 6 null hypotheses on each of the 80 items. Two probability levels are evident in Table 4. For significant differences between employers and graduates for each Engineering Technology, probability levels of .05 and .01 required Chi Square values greater than 5.99 and 9.21, respectively. Nonsignificant differences between groups are denoted by "NS" in Table 4.

In the last two columns of Table 4 a summary of the significant differences for the six null hypotheses is presented. Entries into the column "N" denote the number of items out of 80 items where significant differences existed for a given hypothesis. The column headed "%" gives the percentage of significant differences out of 80 items for each of the 6 hypotheses.

In general, the Chi Square analysis indicated that Architectural graduates and their employers significantly differed on more items - 16 items out of 80 items or 20 percent - than any other group. Both Civil and Computer groups of graduates and employers significantly differed on 16 percent, or 13 out of the 80 items. Electronics graduates and employers differed significantly on only 8 out of 80 items, or 10 percent.

Table 4 - Summary of Chi Square Analysis

	A.1.	A.2.	A.3.	A.4.	A.5.	B.1.
Architectural	NS	NS	.05	NS	NS	NS
Chemical	NS	NS	NS	NS	NS	NS
Civil	NS	NS	NS	NS	NS	.05
Computer	NS	NS	NS	NS	NS	NS
Electronics	NS	NS	NS	NS	NS	NS
Industrial	NS	NS	NS	NS	NS	NS

	B.2.	B.3.	B.4.	B.5.	B.6.	B.7.
Architectural	NS	NS	NS	NS	NS	NS
Chemical	NS	NS	NS	NS	NS	NS
Civil	.05	NS	NS	NS	NS	.01
Computer	NS	NS	NS	NS	NS	NS
Electronics	NS	NS	NS	NS	NS	NS
Industrial	NS	NS	NS	NS	NS	NS

	C.1.	C.2.	C.3.	C.4.	D.1.	D.2.
Architectural	NS	NS	NS	NS	NS	.05
Chemical	NS	NS	NS	NS	NS	NS
Civil	.05	NS	NS	NS	NS	NS
Computer	.05	NS	NS	NS	NS	.05
Electronics	NS	NS	NS	NS	NS	.05
Industrial	NS	NS	NS	NS	NS	NS

Table 4 - Summary of Chi Square Analysis

	E.1.	E.2.	E.3.	F.1.	F.2.	F.3.
Architectural	NS	NS	NS	NS	.05	NS
Chemical	NS	NS	NS	NS	NS	.05
Civil	NS	NS	NS	NS	NS	.05
Computer	.05	.05	NS	NS	.05	.05
Electronics	NS	NS	NS	NS	NS	NS
Industrial	NS	NS	NS	NS	NS	NS

	G.1.	G.2.	G.3.	G.4.	G.5.	H.1.
Architectural	NS	NS	NS	NS	NS	NS
Chemical	NS	NS	NS	.05	NS	NS
Civil	NS	NS	NS	NS	NS	NS
Computer	NS	NS	NS	NS	NS	NS
Electronics	NS	NS	NS	NS	NS	NS
Industrial	NS	NS	.05	NS	NS	NS

	H.2.	H.3.	H.4.	H.5.	H.6.	I.1.
Architectural	.05	NS	NS	NS	NS	NS
Chemical	NS	NS	NS	NS	NS	NS
Civil	NS	NS	NS	NS	NS	NS
Computer	NS	NS	NS	NS	NS	NS
Electronics	NS	NS	NS	NS	NS	NS
Industrial	NS	NS	NS	NS	NS	NS

Table 4 - Summary of Chi Square Analysis

	I.2.	I.3.	I.4.	I.5.	J.1.	J.2.
Architectural	.05	.05	NS	.05	NS	NS
Chemical	NS	NS	NS	NS	NS	NS
Civil	NS	NS	.05	NS	NS	NS
Computer	NS	NS	NS	NS	NS	NS
Electronic	NS	NS	NS	NS	NS	NS
Industrial	NS	NS	NS	NS	NS	NS

	K.1.	K.2.	K.3.	K.4.	K.5.	K.6.
Architectural	NS	NS	NS	NS	NS	NS
Chemical	NS	NS	NS	NS	NS	NS
Civil	NS	NS	NS	NS	NS	NS
Computer	NS	NS	NS	NS	NS	NS
Electronic	NS	NS	NS	NS	NS	NS
Industrial	NS	NS	NS	NS	NS	NS

	K.7.	K.8.	K.9.	K.10.	K.11.	K.12.
Architectural	NS	NS	NS	NS	NS	NS
Chemical	NS	NS	NS	NS	NS	NS
Civil	NS	NS	NS	NS	.05	NS
Computer	NS	NS	NS	NS	NS	NS
Electronic	NS	NS	NS	NS	NS	NS
Industrial	NS	NS	NS	NS	NS	NS

Table 4 - Summary of Chi Square Analysis

	K.13.	K.14.	L.1.	L.2.	L.3.	L.4.
Architectural	NS	NS	NS	NS	NS	NS
Chemical	.05	.05	NS	NS	NS	NS
Civil	NS	NS	NS	NS	NS	NS
Computer	NS	NS	NS	.05	NS	NS
Electronics	NS	NS	NS	NS	NS	NS
Industrial	NS	NS	NS	NS	NS	NS

	L.5.	L.6.	M.1.	M.2.	N.1.	N.2.
Architectural	NS	NS	.05	NS	NS	NS
Chemical	NS	NS	NS	NS	NS	NS
Civil	NS	NS	.05	NS	NS	.05
Computer	NS	NS	NS	NS	.05	NS
Electronics	NS	.05	NS	NS	NS	NS
Industrial	NS	NS	NS	NS	NS	NS

	O.1.	O.2.	O.3.	O.4.	P.1.	P.2.
Architectural	NS	NS	NS	NS	.05	NS
Chemical	NS	NS	NS	NS	NS	NS
Civil	NS	NS	NS	.01	NS	.05
Computer	NS	NS	NS	NS	.05	.05
Electronics	NS	.05	.05	.05	NS	NS
Industrial	NS	NS	NS	NS	NS	NS

Table 4 - Summary of Chi Square Analysis

	P.3.	P.4.	P.5.	Q.1.	Q.2.	Q.3.
Architectural	.05	.05	NS	.01	.01	.01
Chemical	NS	NS	NS	NS	.05	.05
Civil	.05	.05	NS	NS	NS	NS
Computer	.05	.05	.01	NS	NS	NS
Electronic	.05	.05	.05	NS	NS	NS
Industrial	NS	NS	NS	NS	NS	NS

	Q.4.	Q.5.	Summary	
			N	%
Architectural	.01	.01	16	20%
Chemical	NS	NS	6	8%
Civil	NS	NS	13	16%
Computer	NS	NS	13	16%
Electronic	NS	NS	8	10%
Industrial	NS	NS	1	1%

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Graduates and employers associated with Industrial Engineering Technology differed significantly on only one item out of the 80.

Analysis of the Seventeen Major Topics by Engineering Technology

An analysis of the responses of the groups of employers, graduates and the combined group of employers and graduates for each of the 6 Engineering Technologies is presented in the following paragraphs. Each of the 80 items is grouped under one of 17 major topics and the responses of employers and graduates by Engineering Technology are discussed by major topic. The frequency of responses by group are presented in tables in Appendix B for Architectural Technology, Appendix C for Chemical Technology, Appendix D for Civil Engineering Technology, Appendix E for Computer Technology, Appendix F for Electronic Engineering Technology, and Appendix G for Industrial Engineering Technology. The location of the tables upon which the following paragraphs are based is given in parentheses following each major topic. The items appearing in the tables in the Appendices are abbreviated. The complete items appear on the questionnaire in Appendix A.

In order to generalize in relation to the respondents' opinions on an item, minimum percentages for the needed and not needed ends of the continuum were arbitrarily assigned. More explicitly, 50 percent of the responses for a group had to fall into one of the 3 response categories - ESSENTIAL, DESIRABLE, NOT NEEDED - in order to reflect consensus or a majority. For items where 50 percent of the responses did not fall in one of the 3 response categories, the frequency of responses in percent was examined to determine if responses were on the needed - ESSENTIAL or DESIRABLE - or not needed - NOT NEEDED - end of the continuum. In many instances, generalizations have been deduced from the analysis of the responses to a topic and are included in the analysis of the particular topic.

Architectural Technology

MECHANICS (Appendix B, Table 6): Under this topic, the items STATICS, PROPERTIES OF MATERIALS, and STRENGTH OF MATERIALS received the strongest support, with at least 87 percent of all groups responding that these subjects were either essential or desirable. It is interesting to note that in these areas, the group of employers and the group of graduates differed consistently in judging each item as essential or desirable. Employers responded more strongly to each as desirable knowledge, whereas graduates selected the ESSENTIAL response more frequently. In fact, on STRUCTURE, PROPERTIES OF MATERIALS, this difference was statistically significant at the .05 level. Employers felt that FLUID MECHANICS was knowledge not needed whereas graduates' responses were more favorable. The response to DYNAMICS was negative with 50 percent of employers and 37 percent of the graduates responding NOT NEEDED. Still a large proportion of each of these groups indicated FLUID MECHANICS and DYNAMICS were desirable knowledge. It may be concluded that these two areas are potentially useful subjects which should be considered for study in an Architectural Technology curriculum if time permits.

FUNDAMENTALS OF ELECTRICITY/ELECTRONICS (Appendix B, Table 7): Employers were in strong agreement that these items were not essential. However, responses of this group were on the needed end of the continuum for two items: A.C. ELECTRICITY and ELECTRICAL DEVICES. Except for these two items, at least 64 percent of the employers' responses indicated that the information was not needed. Graduates' responses were more favorable than employers' responses to the items under this topic. However, over half of this group selected the NOT NEEDED response for MAGNETIC FIELDS, ELECTRONICS, and ELECTROMAGNETICS. Approximately half of the three groups responded that knowledge of A.C. ELECTRICITY and ELECTRICAL DEVICES was desirable, with graduates responding similarly in the area of D.C. ELECTRICITY. Evidently, the consensus is that this topic is not essential for adequate job performance, while familiarity with practical aspects of electricity is desirable.

LIGHT (Appendix B. Table 8): There was a consensus among the group of employers and the group of graduates that three of the four items listed under LIGHT were not needed. The exception was the item GENERAL THEORY which received approximately 25 percent of both groups' responses under the ESSENTIAL response category. The remainder of the responses of these groups were evenly divided between the other two response categories. It may be concluded that little more than an introduction to the theory of light is useful to architectural technicians.

SOUND (Appendix B, Table 9): Less than 19 percent of the employers and the graduates reported that knowledge of the two items listed under this topic was essential. However, there was a consensus among respondents in the combined group that both items were needed. On the item RECEPTION AND TRANSMISSION, there was a difference of opinion significant at the .05 level as 62 percent of the graduates responded desirable, whereas 64 percent of the employers rejected it as not needed. There was a consensus among groups of respondents that a knowledge of general theory of sound is desirable.

HEAT (Appendix B, Table 10): Forty-three percent of employers and 31 percent of the graduates responded that knowledge of the GENERAL THEORY of HEAT was essential. The same response was made to HEAT TRANSFER by 20 percent of the employers and 50 percent of the graduates. There was a consensus among all three groups that knowledge of this item was desirable. The overall response was much less positive for THERMODYNAMICS. In fact, approximately 47 percent of all respondents in the combined group indicated that this item was not needed in performing their jobs.

According to respondents, course work in the fundamentals of heat and heat transfer is desirable in an Architectural Technology Program.

MODERN PHYSICS (Appendix B, Table 11): Both the group of employers and the group of graduates strongly agreed that information under this topic was not needed. In fact, this response was checked by 100 percent of the employers and nearly two-thirds of the graduates. The fact that 37 percent of the graduates selected the DESIRABLE category for the item RELATIVITY constituted a difference of opinion significant at the .05 level.

Results of this survey indicate that there is not a need for this topic in a course of study in this field.

CHEMISTRY (Appendix B, Table 12): Respondents in each group agreed that a knowledge of CHEMISTRY is not needed by technicians in this field. Specifically, 62 percent or more of both the group of employers and the group of graduates checked the NOT NEEDED response category on each item listed under this topic.

BIOLOGY (Appendix B, Table 13): Four of the 5 items listed under BIOLOGY were not needed according to a majority of responses in the employer group and the graduate group. The exception, ECOLOGY, received 50 percent of all groups' responses on the needed end of the continuum.

Under MICROBIOLOGY, 100 percent of employer responses were in the NOT NEEDED category, whereas 33 percent of the graduates selected the DESIRABLE response. This difference was statistically significant at the .05 level. The consensus among all respondents was that each of these items is not needed.

GEOLOGY (Appendix B, Table 14): A majority of the employers responded that a knowledge of PHYSICAL GEOLOGY and HYDROLOGY was desirable. Graduates agreed with 63 percent responding DESIRABLE to PHYSICAL GEOLOGY and 75 percent responding likewise to HYDROLOGY. On the remaining items, at least 79 percent of employers agreed that this information was not needed. Graduates, on the other hand, rejected only one item, GEOPHYSICS, with 50 percent checking the NOT NEEDED response category. The difference in employer responses and graduate responses was statistically significant (.05 level) on three of these items, ECONOMIC GEOLOGY, STRUCTURAL GEOLOGY, and HYDROLOGY.

Based on the responses to the items under this topic, a knowledge of PHYSICAL GEOLOGY and HYDROLOGY would be desirable.

DATA PROCESSING (Appendix B, Table 15): There was a consensus among respondents in the group of employers and the group of graduates that neither FORTRAN nor BASIC was needed by architectural technicians.

Three graduates listed other data processing topics on the questionnaire. The three topics listed were ASL programming language, COBOL language and basic programming concepts.

ALGEBRA (Appendix B, Table 16): Approximately 75 percent of the graduates responded on the needed end of the continuum to all items listed under ALGEBRA. With only 4 exceptions, over two-thirds of the employers agreed. Only 50 percent of the employers responded on the needed end of the continuum to the items SCIENTIFIC NOTATION, INEQUALITIES, and SERIES;EXPANSIONS, and 64 percent of the employers indicated that a knowledge of COMPLEX AND IMAGINARY NUMBERS was not needed. The strongest collective responses were recorded under the items EQUATIONS AND WORD PROBLEMS, FRACTIONS, and RATIO AND PROPORTION, where approximately two-thirds or more of all respondents checked the ESSENTIAL category. There was also a consensus that the item ALGEBRAIC EXPRESSIONS was essential knowledge in this field.

In general, respondents indicated that an architectural technician should have a knowledge of ALGEBRA.

TRIGONOMETRY (Appendix B, Table 17): With only one exception, at least 50 percent of the respondents in the group of employers and the group of graduates indicated that each of the items listed under this topic was essential. The exception was INVERSE TRIG FUNCTIONS, where 64 percent of the employers responded DESIRABLE. In general, there was agreement between employers and graduates that the items listed under this topic were either ESSENTIAL or DESIRABLE knowledge for an architectural technician.

LOGARITHMS (Appendix B, Table 18): A majority of the graduates responded DESIRABLE to the two items under LOGARITHMS whereas a majority of the employers responded NOT NEEDED to both items. This difference of opinion was statistically significant at the .05 level for one item, EXPONENTIAL AND LOG FUNCTION.

However, the combined group responded on the needed end of the continuum to both items.

GEOMETRY (Appendix B, Table 19): A majority of each response group indicated that PLANE GEOMETRY and SOLID GEOMETRY were essential in the work of an architectural technician.

ANALYTIC GEOMETRY (Appendix B, Table 20): Over 80 percent of the employers' group and the graduates' group indicated that the first 2 items, RECTANGULAR COORDINATES and SOLVING EQUATIONS GRAPHICALLY, were either essential or desirable. However, the need for the last 2 items, GRAPHS OF LOG FUNCTIONS and POLAR COORDINATES, was less evident as a majority of employers responded DESIRABLE, and approximately one-third indicated NOT NEEDED.

Both groups, as well as the combined group, responded on the needed end of the continuum to all items listed under this topic.

CALCULUS (Appendix B, Table 21): Graduates responded on the needed end of the continuum to all items listed under CALCULUS while employers responded similarly to only two items, DIFFERENTIATION and INTEGRATION. The differences between employers' and graduates' responses were statistically significant (.05 level) on all except INTEGRATION. There was consensus among the respondents in the combined group that all items except LAPLACE TRANSFORMS were needed by architectural technicians.

STATISTICS (Appendix B, Table 22): Employers overwhelmingly rejected each of these items listed under STATISTICS as not needed. However, at least 44 percent of the graduates responded under the DESIRABLE category in each case. Moreover, a sizeable percentage of graduates viewed these items as essential. Consequently, differences between the responses of the employers and the graduates were significant (.01 level) on each item.

Chemical Technology

MECHANICS (Appendix C, Table 23): Employers were equally divided in their response to STATICS, FLUID MECHANICS, and STRENGTH OF MATERIALS with one-third of the responses falling into each of the response categories. Employers were stronger in their response on the remaining items with 66 percent responding DESIRABLE to DYNAMICS and 100 percent responding ESSENTIAL to PROPERTIES OF MATERIALS.

There was a consensus among graduates that knowledge of STATICS, FLUID MECHANICS, PROPERTIES OF MATERIALS, and DYNAMICS was desirable for chemical technicians in performing job duties. However, 83 percent of the graduates responded NOT NEEDED to STRENGTH OF MATERIALS.

Over 50 percent of the combined group's responses were on the needed end of the continuum for 4 of the 5 items. Only one item, STRENGTH OF MATERIALS, received a negative response with two-thirds of the combined group's responses falling in the NOT NEEDED category.

FUNDAMENTALS OF ELECTRICITY/ELECTRONICS (Appendix C, Table 24): None of the 7 items listed under the FUNDAMENTALS OF ELECTRICITY/ELECTRONICS was evaluated by the three groups to be essential knowledge for chemical technicians. However, employers responded that knowledge of MAGNETIC FIELDS, D.C. ELECTRICITY, A.C. ELECTRICITY, and ELECTRICAL DEVICES was desirable. A majority of the graduates responded DESIRABLE to only one item, D.C.

ELECTRICITY. Fifty percent or more of the graduates responded NOT NEEDED to the remaining items.

LIGHT (Appendix C, Table 25): Graduates and employers differed in their responses to the 4 items listed under LIGHT. For example, a majority of the employers responded NOT NEEDED to the 4 items while 50 percent or more of the graduates' responses were on the needed end of the continuum. However, only one item, GEOMETRICAL OPTICS, received a majority of the combined group responses on the not needed end of the continuum.

SOUND (Appendix C, Table 26): A knowledge of the GENERAL THEORY OF SOUND was desirable according to graduates while employers unanimously responded that it was not needed. Agreement between the group of employers and the group of graduates was more evident on the item RECEPTION AND TRANSMISSION with two-thirds of the employers and one-half of the graduates responding NOT NEEDED.

HEAT (Appendix C, Table 27): The combined group of employers and graduates supported the study of the 3 items listed under HEAT with over three-fourths of the responses falling on the needed end of the continuum. Gradautes were more adamant in their support with over 50 percent responding ESSENTIAL to GENERAL THEORY, HEAT TRANSFER, and THERMODYNAMICS. A majority of the employers responded ESSENTIAL to only one item, GENERAL THEORY.

MODERN PHYSICS (Appendix C, Table 28): Only one item, RELATIVITY, did not receive a majority of the employers' responses on the needed end of the continuum. Two-thirds of the employers did respond on this end of the continuum to the remaining items, STRUCTURE OF ATOM and FISSION, FUSION, RADIOACTIVITY. Graduates were more adamant in their support of the items under MODERN PHYSICS with a majority responding ESSENTIAL to all items. Only one item, RELATIVITY, did not receive a majority of the combined group's responses in the ESSENTIAL response category.

CHEMISTRY (Appendix C, Table 29): A majority of the employers and graduates agreed that knowledge of GENERAL CHEMISTRY, QUALITATIVE CHEMISTRY and QUANTITATIVE CHEMISTRY was essential for a chemical technician in performing job duties. Graduates were equally adamant about PHYSICAL CHEMISTRY and ORGANIC CHEMISTRY with over two-thirds responding ESSENTIAL. In general, there was consensus among respondents in the combined group that knowledge of all items under CHEMISTRY was essential.

BIOLOGY (Appendix C, Table 30): One item, MICROBIOLOGY, received a majority of employers' responses and graduates' responses in the ESSENTIAL response category. Three items, GENERAL BIOLOGY, MICROBIOLOGY, and ECOLOGY, received a majority of the combined group's responses on the needed end of the continuum. There was a consensus among respondents in the combined group that knowledge of the remaining items, BOTANY, ZOOLOGY, and GENETICS was not needed by chemical technicians in performing their job duties.

GEOLOGY (Appendix C, Table 31): A majority of the combined group responded NOT NEEDED to PHYSICAL GEOLOGY, STRUCTURAL GEOLOGY, GEOPHYSICS, and HYDROLOGY. Responses to the remaining item, ECONOMIC GEOLOGY, were equally divided among the response categories for each group.

DATA PROCESSING (Appendix C, Table 32): Employers and graduates differed in their responses to the two programming languages listed under DATA PROCESSING. Employers were clearly opposed to a study of these items with 100 percent responding NOT NEEDED to FORTRAN while 66 percent responded NOT NEEDED to BASIC. Graduates' responses indicated that knowledge of both FORTRAN and BASIC was desirable with 50 percent of this group responding DESIRABLE to FORTRAN and 83 percent responding similarly to BASIC. In general, there was consensus among respondents in the combined group that knowledge of both FORTRAN and BASIC was needed.

ALGEBRA (Appendix C, Table 33): The responses of the 3 groups to 9 items listed under ALGEBRA indicated that these items represented essential knowledge for a chemical technician. The 9 items were EXPONENTS AND RADICALS, SCIENTIFIC NOTATION, ALGEBRAIC EXPRESSIONS, EQUATIONS AND WORD PROBLEMS, SOLUTIONS TO SYSTEMS OF EQUATIONS, FACTORING, FRACTIONS, QUADRATIC EQUATIONS and RATIO AND PROPORTION. The responses of the 3 groups to 2 items, DETERMINANTS and INEQUALITIES, clearly indicated that knowledge of these items was desirable. On the other hand, graduates and employers differed in their responses to the remaining items, COMPLEX AND IMAGINARY NUMBERS, PROGRESSIONS, and SERIES;EXPANSIONS. Two-thirds of the employers responded NOT NEEDED to these items while a majority of the graduates responded either DESIRABLE or ESSENTIAL to these items. Even on these three items however analysis of the combined group's responses indicated support on the needed end of the continuum. The combined group offered its weakest support to complex and imaginary numbers where one-third of the responses was in the NOT NEEDED category. The difference between employer responses and graduate responses to PROGRESSIONS and SERIES; EXPANSIONS was statistically significant at the .05 level.

In general, there was consensus among the combined group that knowledge of the 14 items listed under ALGEBRA was either desirable or essential.

TRIGONOMETRY (Appendix C, Table 34): There was a consensus among respondents of each of the 3 groups that the 6 items listed under TRIGONOMETRY reflected either essential or desirable knowledge. A majority of the graduates responded ESSENTIAL to each of the 6 items. A majority of the employers checked this response category on only one item, RIGHT TRIANGLES. Three items, ANGLES, TRIGONOMETRIC FUNCTIONS, and OBLIQUE TRIANGLES, were checked as desirable knowledge by a majority of the employers. Employers' responses on the remaining two items, GRAPHS OF TRIG FUNCTIONS and INVERSE TRIG FUNCTIONS were equally divided among the 3 response categories.

In general, a consensus was evident among respondents in the combined group that a knowledge of the 6 items under TRIGONOMETRY was either desirable or essential.

LOGARITHMS (Appendix C, Table 35): Fifty percent of the graduates responded ESSENTIAL to EXPONENTIAL AND LOG FUNCTIONS and LOGS OF TRIG FUNCTIONS, while two-thirds of the employers responded DESIRABLE to these items. Over three-fourths of the combined group responded on the needed end of the continuum to these items.

GEOMETRY (Appendix C, Table 36): Seventy-seven percent of the combined group responded on the needed end of the continuum to the two items listed under GEOMETRY. An analysis of the employers' responses indicated that two-thirds of this group responded ESSENTIAL to PLANE GEOMETRY and SOLID GEOMETRY. An equal number of graduates, on the other hand, responded DESIRABLE to these items.

ANALYTIC GEOMETRY (Appendix C, Table 37): A majority of the graduates responded DESIRABLE to each of the 4 items under ANALYTIC GEOMETRY. Employers were not as consistent in their responses with 66 percent responding DESIRABLE on the item POLAR COORDINATES, 66 responding NOT NEEDED to GRAPHS OF LOG FUNCTIONS, and an equal distribution of responses among the 3 response categories on the remaining items.

In general, the combined group's responses were supportive of a study of the items under ANALYTIC GEOMETRY.

CALCULUS (Appendix C, Table 38): Of the 5 items listed under CALCULUS, only one item, LAPLACE TRANSFORMS, received a majority of each group's responses in the NOT NEEDED response category. A majority of the graduates responded ESSENTIAL to the remaining items. Employers, on the other hand, were less adamant in their support with 66 percent responding DESIRABLE to DIFFERENTIATION OF FUNCTIONS and the same percentage checked NOT NEEDED to DIFFERENTIAL EQUATIONS.

STATISTICS (Appendix C, Table 39): Employers supported the study of only one item, PROBABILITY, with 100 percent of the respondents checking DESIRABLE. The remaining items were not needed according to two-thirds of the employers.

Graduates differed with employers on all items. The difference on two items, FREQUENCY DISTRIBUTIONS and VARIABILITY, was statistically significant at the .05 level. A majority of the graduates differed from their employers by responding ESSENTIAL to PROBABILITY, FREQUENCY DISTRIBUTION and VARIABILITY. Graduates responded DESIRABLE to only one item, SAMPLING THEORY, while their responses to HYPOTHESIS TESTING were equally distributed among the 3 response categories.

In general, the combined group's responses were on the needed end of the continuum to all items.

Civil Engineering Technology

MECHANICS (Appendix D, Table 40): There was strong agreement between both the group of employers and the group of graduates that all items under MECHANICS were either essential or desirable knowledge for adequate job performance. Two items, STATICS and STRENGTH OF MATERIALS, received the strongest support with over 50 percent of each group and 60 percent of the combined group responding ESSENTIAL. In addition, the item PROPERTIES OF MATERIALS received 52 percent of the employers' and 49 percent of the graduates' responses in the ESSENTIAL category.

In conclusion, there was agreement between employers and graduates that a knowledge of the items under MECHANICS is important for civil engineering technicians.

FUNDAMENTALS OF ELECTRICITY/ELECTRONICS (Appendix D, Table 41): At least 47 percent of the employers' group and the graduates' group indicated that knowledge of ELECTRIC FIELDS, MAGNETIC FIELDS, ELECTRONICS, and ELECTROMAGNETICS was not needed in their work. Graduates did significantly differ (.05 level) with their employers on these items by responding DESIRABLE more frequently. Some support was evident for three items: D.C. ELECTRICITY, A.C. ELECTRICITY, and ELECTRICAL DEVICES. These items received a majority of the combined group's responses on the needed end of the continuum. There was agreement among all groups that the items in this area are not essential, since the selection of this repsonse never exceeded 10 percent on any item.

LIGHT (Appendix D, Table 42): Employers agreed (at least 64 percent) that a knowledge of this topic was not needed for adequate job performance. A majority of the graduates, on the other hand, responded on the needed end of the continuum to 2 items, GENERAL THEORY OF LIGHT and GEOMETRICAL OPTICS. The difference in employer responses and graduate responses to GENERAL THEORY was statistically significant at the .05 level.

SOUND (Appendix D, Table 43): The consensus of the combined group and the group of employers was that a knowledge of the items listed under SOUND was not needed. The graduates, however, differed with these groups on one item, GENERAL THEORY. In this case, a majority of the graduates responded on the needed end of the continuum to this item.

HEAT (Appendix D, Table 44): A majority of the combined group responded on the needed end of the continuum to all items listed under HEAT. Of the 2 response categories on this end of the continuum, DESIRABLE was checked more frequently by respondents. However, approximately one-third or more of all groups responded that the 3 items were not needed.

It may be concluded that some background in HEAT and HEAT TRANSFER would be useful in this field, but not essential.

MODERN PHYSICS (Appendix D, Table 45): There was a consensus among respondents in all 3 groups that the items listed under MODERN PHYSICS were not needed by civil engineering technicians in performing job duties. Employers and graduates did significantly differ (.05 level) in their responses to one item, FISSION, FUSION, RADIOACTIVITY. In response to this item, 84 percent of the employers checked NOT NEEDED while 35 percent of the graduates indicated that knowledge of this item was desirable.

CHEMISTRY (Appendix D, Table 46): A majority of the respondents in the 3 groups agreed that knowledge of GENERAL CHEMISTRY was desirable for a civil engineering technician. However, over 60 percent of the respondents in each of the groups indicated that the remaining items were not needed.

BIOLOGY (Appendix D, Table 47): A knowledge of the 6 items listed under BIOLOGY is not needed by civil engineering technicians according to a majority of the respondents in the 3 groups.

GEOLOGY (Appendix D, Table 48): A knowledge of HYDROLOGY is essential to a civil engineering technician according to 60 percent or more in each group. In addition, respondents indicated that PHYSICAL GEOLOGY and STRUCTURAL GEOLOGY were desirable items. On the other hand, respondents in the 3 groups could not agree on the value of ECONOMIC GEOLOGY and GEOPHYSICS.

DATA PROCESSING (Appendix D, Table 49): Approximately two-thirds of the 3 responding groups indicated that knowledge of FORTRAN and BASIC was needed by civil technicians. However, their responses were evenly divided between the ESSENTIAL and the DESIRABLE response categories.

Of the 21 employers and graduates who added other data processing topics, 6 listed programming applicable to mini- and micro-computers. However, the most frequently listed programming language other than FORTRAN and BASIC was COBOL. Two graduates and one employer listed this language under OTHER.

ALGEBRA (Appendix D, Table 50): There was agreement among the respondents of each group that a knowledge of 10 of the 14 items listed under ALGEBRA was essential for a civil engineering technician. The remaining 4 items, DETERMINANTS AND MATRICIES, COMPLEX AND IMAGINARY NUMBERS, INEQUALITIES, and SERIES; EXPANSIONS, did not receive a majority of the responses in the essential category; however, over 60 percent of the respondents in each group responded on the needed end of the continuum on these items.

TRIGONOMETRY (Appendix D, Table 51): Over 90 percent of the respondents in each group indicated that a knowledge of ANGLES, TRIGONOMETRIC FUNCTIONS, RIGHT TRIANGLES, and OBLIQUE TRIANGLES was essential for a civil engineering technician in performing duties. Between 60 and 70 percent of the respondents in these groups checked this category for the remaining two items, GRAPHS OF TRIG FUNCTIONS and INVERSE TRIG FUNCTIONS.

LOGARITHMS (Appendix D, Table 52): Over 75 percent of all groups responded on the needed end of the continuum to both items under LOGARITHMS. Employers responded DESIRABLE more frequently on both items than graduates who were evenly divided between the DESIRABLE and the ESSENTIAL response categories. There was a significant difference (.05 level) between employers' responses and graduates' responses on the first item, EXPONENTIAL AND LOG FUNCTIONS.

GEOMETRY (Appendix D, Table 53): Strong support was evident for this topic by all groups. A majority of each group selected the ESSENTIAL response category for both items listed under GEOMETRY. Employers were less than unanimous in their response to the item SOLID GEOMETRY with 16 percent selecting the NOT NEEDED category as compared to 0 percent of the graduates. This resulted in a difference of opinion significant at the .05 level.

ANALYTIC GEOMETRY (Appendix D, Table 54): A majority of all groups checked the ESSENTIAL category on 2 items, RECTANGULAR COORDINATES and SOLVING EQUATIONS GRAPHICALLY. At least 60 percent of each group responded on the needed end of the continuum to the remaining items, GRAPHS OF LOG FUNCTIONS and POLAR COORDINATES.

CALCULUS (Appendix D, Table 55): The combined group responded on the needed end of the continuum to the 5 items listed under CALCULUS. Graduates agreed with the combined group on all items; however, at least 50 percent of the employers responded NOT NEEDED to DIFFERENTIATION OF FUNCTIONS, DIFFERENTIAL EQUATIONS, and LAPLACE TRANSFORMS.

In every case, employers tended to reject the items as not needed in greater percentages than did graduates. In fact, the difference was significant (.05 level) on the items INTEGRATION, DIFFERENTIATION OF FUNCTIONS and DIFFERENTIAL EQUATIONS.

STATISTICS (Appendix D, Table 56): There was a consensus among the respondents in the combined group and the group of graduates that a knowledge of the 5 items listed under STATISTICS was at least desirable for a civil engineering technician. The employers' group differed with these groups by a majority responding NOT NEEDED to FREQUENCY DISTRIBUTION, SAMPLING THEORY and HYPOTHESIS TESTING.

Computer Technology

MECHANICS (Appendix E, Table 57): There was a consensus among the combined group of graduates and employers that all 5 items (STATICS, FLUID MECHANICS, PROPERTIES OF MATERIALS, STRENGTH OF MATERIALS, and DYNAMICS) under MECHANICS were not needed by computer technicians in performing their job duties. The extent of this consensus ranged from 50 percent of the combined group responding that DYNAMICS was not needed to 75 percent of the combined group rejecting STRENGTH OF MATERIALS as needed.

Employers in all cases maintained that the 5 items under MECHANICS were not needed. Graduates, however, indicated that knowledge of STATICS, PROPERTIES OF MATERIALS and DYNAMICS was desirable.

FUNDAMENTALS OF ELECTRICITY/ELECTRONICS (Appendix E, Table 58): The 2 groups of respondents, employers and graduates, when taken individually and together, agreed that knowledge of ELECTRIC FIELDS, MAGNETIC FIELDS, D.C. ELECTRICITY, A.C. ELECTRICITY, ELECTRONICS, and ELECTRICAL DEVICES was essential in performing job duties. Respondents were less certain about the need for ELECTROMAGNETICS. However, 60 percent of the employer responses, 90 percent of the graduates' responses and 85 percent of the combined group's responses were on the needed end of the continuum.

In general, the study of all 7 items under the FUNDAMENTALS OF ELECTRICITY/ELECTRONICS was endorsed by respondents.

LIGHT (Appendix E, Table 59): There was a consensus among employers that all items under the topic LIGHT were not needed by computer technicians in performing job duties. Graduates, on the other hand, indicated that a knowledge of GENERAL THEORY, GEOMETRICAL OPTICS, AND PHYSICAL OPTICS was desirable. Only SPECTRAL ANALYSIS was deemed not needed by both employers and graduates.

An analysis of the combined group's responses indicated that knowledge of GENERAL THEORY, GEOMETRICAL OPTICS, and PHYSICAL OPTICS was desirable. Only SPECTRAL ANALYSIS was deemed not needed by the combined group. The most popular items GENERAL THEORY and PHYSICAL OPTICS still showed a combined group response of only 10 percent in the ESSENTIAL category.

It's interesting to note that the difference in the responses of graduates and employers to GENERAL THEORY was statistically significant at the .05 level. The differences can be attributed to the 90 percent of the graduates who responded that a knowledge of GENERAL THEORY was either desirable or essential as compared to 40 percent of the employers who responded DESIRABLE.

SOUND (Appendix E, Table 60): There was a consensus among employers of Computer Technology graduates that the GENERAL THEORY of SOUND and an understanding of the RECEPTION AND TRANSMISSION of SOUND was not needed in performing job duties. Graduates, on the other hand, differed with their employers on this topic. Seventy percent of graduates responded that an understanding of the GENERAL THEORY was either essential or desirable. RECEPTION AND TRANSMISSION was given even stronger support with 80 percent of the graduates responding that knowledge of this item was either essential or desirable in performing job duties. The difference between employers and graduates on this item was statistically significant at the .05 level.

The responses of the combined group of employers and graduates were on the needed end of the continuum with 55 percent responding that GENERAL THEORY was either desirable or essential and 60 percent responding similarly for RECEPTION AND TRANSMISSION.

HEAT (Appendix E, Table 61): There was a consensus among students that the items listed under HEAT represented desirable knowledge in performing job duties. Employers' responses were on the other end of the continuum with 70 percent responding NOT NEEDED to the GENERAL THEORY and 90 percent to THERMODYNAMICS. The differences in the employers' and graduates' responses were statistically significant at the .05 level for both GENERAL THEORY and HEAT TRANSFER.

As a combined group, employers and graduates favored the study of the first 2 items with 65 percent responding that knowledge of the GENERAL THEORY of SOUND was either desirable or essential and 75 percent responding similarly to HEAT TRANSFER. This group, however, rejected THERMODYNAMICS with 65 percent responding NOT NEEDED.

MODERN PHYSICS (Appendix E, Table 62): There was a consensus among the combined group of employers and graduates that the 3 items under MODERN PHYSICS were not needed. Employers' responses were consistent with the responses of the combined group with at least 40 percent of the employers responding that each item was not needed. Graduates significantly differed (.05 level) with employers on 2 of the 3 items, RELATIVITY and FISSION, FUSION, RADIOACTIVITY. However, at least 70 percent of all graduates' responses were on the needed end of the continuum for each of the 3 items.

CHEMISTRY (Appendix E, Table 63): Each of the 7 items under CHEMISTRY were evaluated as not needed by at least 68 percent of the combined group of employers and graduates. Employers were more adamant in their responses with at least 90 percent responding that each of 7 items was not needed. Seventy percent of the students concurred with the employers on 3 of the 5 items, QUALITATIVE CHEMISTRY, QUANTITATIVE CHEMISTRY, and ORGANIC CHEMISTRY. However, the items GENERAL CHEMISTRY and PHYSICAL CHEMISTRY were considered desirable knowledge by at least 50 percent of the graduates.

BIOLOGY (Appendix E, Table 64): At least 80 percent of both employers and graduates, as well as the combined group, responded that knowledge of the 6 items under BIOLOGY (GENERAL BIOLOGY, MICROBIOLOGY, ECOLOGY, BOTANY, ZOOLOGY, and GENETICS) was not needed by computer technicians in performing their job duties.

GEOLOGY (Appendix E, Table 65): There was a consensus among employers taken as a group, graduates as a group, and the combined group that a knowledge of PHYSICAL GEOLOGY, ECONOMIC GEOLOGY, STRUCTURAL GEOLOGY, GEOPHYSICS and HYDROLOGY was not needed in performing job duties.

DATA PROCESSING (Appendix E, Table 66): The responses of the combined group were consistent with the responses of the employers as a group and the graduates as a group to items under this topic. Knowledge of FORTRAN and BASIC programming languages was desirable according to the 3 groups with over 50 percent of the respondents in each group checking the DESIRABLE response category. Both FORTRAN and BASIC programming languages were desirable according to the 3 groups with over 50 percent of the respondents in each group checking the DESIRABLE category. Both items, FORTRAN and BASIC, received approximately the same number of responses per group on the needed end of the continuum.

Respondents to the third item under DATA PROCESSING listed other data processing topics. A total of 8 graduates and 13 employers added information. The most frequently listed topic was COBOL with 3 graduates and 4 employers listing this programming language. Assembler, Machine Language and PL/1 were listed a total of 3 times by employers and graduates.

Other topics listed less frequently were APL, BAL, RPG and basic programming concepts.

ALGEBRA (Appendix E, Table 67): A majority of the responses of each of the 3 groups was on the needed end of the continuum for all but 2 of the 14 items under ALGEBRA. There was a consensus among employers that knowledge of SCIENTIFIC NOTATION and SERIES;EXPANSIONS was not needed by computer technicians in performing job duties. Graduates, on the other hand, supported the study of all 14 items under ALGEBRA with over 60 percent of the graduates responding that knowledge of EXPONENTS AND RADICALS, SCIENTIFIC NOTATION, ALGEBRAIC EXPRESSIONS, EQUATIONS AND WORD PROBLEMS, SOLUTIONS TO SYSTEMS OF EQUATIONS, FACTORING, QUADRATIC EQUATIONS, and RATIO AND PROPORTIONS was essential in performing job duties.

TRIGONOMETRY (Appendix E, Table 68): Graduates and employers differed significantly (.05 level) on only one item, TRIGONOMETRIC FUNCTIONS, under the topic TRIGONOMETRY. On this item, 50 percent of the employers responded NOT NEEDED while a majority of graduates responded ESSENTIAL. The combined group shared the views of the graduates with a majority of their responses falling on the needed end of the continuum on each item.

LOGARITHMS (Appendix E, Table 69): Employers and graduates agreed that EXPONENTIAL AND LOG FUNCTIONS and LOGS OF TRIG FUNCTIONS represented at least desirable knowledge for a computer technician. More specifically, at least 50 percent of the graduates responded that these items were essential while at least 62 percent of the employers responded that these items were desirable.

GEOMETRY (Appendix E, Table 70): Of the 2 items listed under the topic GEOMETRY, employers and graduates significantly differed (.05 level) in their responses to the need for a knowledge of PLANE GEOMETRY. Sixty-two percent of the employers responded NOT NEEDED to this item while 70 percent of the graduates indicated that a knowledge of this item was DESIRABLE.

Responses to the second item, SOLID GEOMETRY, were similar; however, the difference was not statistically significant. Sixty-two percent of the employers checked the NOT NEEDED response category while 60 percent of the graduates responded that a knowledge of this item was desirable.

ANALYTIC GEOMETRY (Appendix E, Table 71): The employers agreed that knowledge of the four items, RECTANGULAR COORDINATES, SOLVING EQUATIONS GRAPHICALLY, GRAPHS OF LOG FUNCTIONS, and POLAR COORDINATES, listed under ANALYTIC GEOMETRY was not needed by computer technicians in performing job duties. A majority of the graduates, on the other hand, responded either DESIRABLE or ESSENTIAL to the 4 items. Fifty percent of the graduates responded ESSENTIAL to SOLVING EQUATIONS GRAPHICALLY while an equal percentage responded DESIRABLE to the remaining 3 items.

A majority of the responses of the combined group did not fall in any one response category; however, the responses of the combined group did fall on the needed end of the continuum for all 4 items with over 50 percent of this group checking either DESIRABLE or ESSENTIAL.

CALCULUS (Appendix E, Table 70): Employers and graduates differed significantly (.05 level) on all items listed under CALCULUS. Employers were adamant in their opposition to the study of CALCULUS with 75 percent or more of the respondents checking NOT NEEDED for each of the 5 items. Graduates responded on the needed end of the continuum with at least 50 percent checking ESSENTIAL on all but one item, LAPLACE TRANSFORMS. On this item, 60 percent of the graduates checked DESIRABLE.

A consensus was evident for the combined group of employers and graduates with at least 50 percent of the responses falling in the not needed category for 4 of the 5 items. DIFFERENTIAL EQUATIONS was the only item where over 50 percent of the responses were on the needed end of the continuum.

STATISTICS (Appendix E, Table 73): There was a consensus between employers and graduates with at least 50 percent of the respondents for each group indicating that knowledge of PROBABILITY, FREQUENCY DISTRIBUTIONS, VARIABILITY, and SAMPLING THEORY was not needed by computer technicians in performing job duties. However, 55 percent of the employers did respond that knowledge of the fifth item, HYPOTHESIS TESTING, was desirable. Graduates differed with their employers on this item with 50 percent responding NOT NEEDED.

The response pattern of the combined group followed that of the employers and graduates as over 50 percent of the combined group responded NOT NEEDED for 4 of the 5 items listed under STATISTICS. HYPOTHESIS TESTING had 47 percent of the combined group responding NOT NEEDED.

Electronic Engineering Technology

MECHANICS (Appendix F, Table 74): Responses of the employers and graduates to the 5 items under MECHANICS were split between the DESIRABLE and the NOT NEEDED response categories. Fifty percent or more of the employers responded that a knowledge of STATICS, FLUID MECHANICS, PROPERTIES OF MATERIALS and STRENGTH OF MATERIALS was not needed by electronics technicians in performing job duties. Only one item, DYNAMICS, had 50 percent of the employer responses under DESIRABLE.

Graduates responded negatively to only one item, STRENGTH OF MATERIALS, with two-thirds of the responses falling under the NOT NEEDED category. The remaining 4 items were evaluated as desirable knowledge by the graduates.

A review of the combined group's responses indicated a split similar to each individual group. Over 50 percent of the combined group responded that knowledge of STATICS, PROPERTIES OF MATERIALS and DYNAMICS was desirable. Approximately two-thirds of this same group indicated that knowledge of FLUID MECHANICS and STRENGTH OF MATERIALS was not needed.

FUNDAMENTALS OF ELECTRICITY/ELECTRONICS (Appendix F, Table 75): There was a consensus between the employers as a group and the graduates as a group that knowledge of all 7 items under this topic was essential in performing the duties of electronics technicians. The weakest endorsement was given to ELECTROMAGNETICS with 54 percent of the employers, 75 percent of the graduates, and 67 percent of the combined group responding ESSENTIAL to this item.

LIGHT (Appendix F, Table 76): A consensus was evident among the graduates that knowledge of the GENERAL THEORY of LIGHT, GEOMETRICAL OPTICS, PHYSICAL OPTICS and SPECTRAL ANALYSIS is desirable. Employers agreed with graduates on only one item with over 50 percent of the employers responding DESIRABLE to GEOMETRICAL OPTICS. Employers were more supportive of the item GENERAL THEORY with over 70 percent responding on the needed end of the continuum.

The responses of the combined group appeared to support the study of all items listed under LIGHT with over 50 percent of the responses on the needed end of the continuum.

SOUND (Appendix F, Table 77): There was a consensus among respondents in the combined group supporting a study of the GENERAL THEORY of SOUND and the RECEPTION AND TRANSMISSION of SOUND. However, graduates and employers did differ in the extent of their support. Seventy-five percent of the employers responded DESIRABLE to GENERAL THEORY and 60 percent of this same group checked DESIRABLE to the item RECEPTION AND TRANSMISSION. Graduates were more supportive with 52 percent of the graduates responding that knowledge of both items is essential for an electronics technician performing his job duties.

Differences between graduates and employers were statistically significant at the .05 level for the second item, RECEPTION AND TRANSMISSION.

HEAT (Appendix F, Table 78): Employers were more favorable toward the study of HEAT than graduates. There was a consensus among employers that knowledge of the GENERAL THEORY of HEAT, HEAT TRANSFER, and THERMODYNAMICS is desirable. Graduates, on the other hand, were less adamant in their support with 47 percent responding DESIRABLE to GENERAL THEORY, 52 percent to HEAT TRANSFER and 36 percent to THERMODYNAMICS. The responses of the combined group were similar to the responses of each individual group with at least 50 percent of the respondents responding on the needed end of the continuum on all items.

HEAT (Appendix F, Table 79): The combined responses of employers and graduates indicated support for the study of the 3 items under MODERN PHYSICS. Employers as a group differed from the combined group with at least 50 percent of the employers indicating that a knowledge of RELATIVITY and FISSION, FUSION, RADIOACTIVITY was not needed by electronics technicians in performing job duties. The employers did respond that the study of the STRUCTURE OF ATOM was desirable. Graduate responses followed more closely the response pattern of the combined group with over 75 percent of the respondents responding on the needed end of the continuum to all 3 items.

CHEMISTRY (Appendix F, Table 80): GENERAL CHEMISTRY was the only item listed under CHEMISTRY that received unanimous endorsement of both groups of respondents as well as the combined group. Over 60 percent of respondents in each group responded on the needed end of the continuum. There was a consensus among respondents in each of the groups that the remaining items, QUALITATIVE, QUANTITATIVE, PHYSICAL, and ORGANIC CHEMISTRY, were not needed by electronics technicians in performing job duties.

BIOLOGY (Appendix F, Table 81): Knowledge of BIOLOGY is not needed by electronic technicians in performing job duties according to the respondents of all groups. For 2 items, BOTANY and ZOOLOGY, each group unanimously responded NOT NEEDED. The responses for the remaining 4 items ranged from 70 percent of the total to 100 percent of the total falling under the NOT NEEDED response category.

GEOLOGY (Appendix F, Table 82): The respondents in the 3 groups overwhelmingly responded that knowledge of the 5 topics listed under GEOLOGY was

was not needed by electronic technicians in performing their job duties. The extent of their response originated from 70 percent of the employers responding NOT NEEDED to 2 items, ECONOMIC GEOLOGY and PHYSICAL GEOLOGY, to 94 percent of the graduates responding similarly to STRUCTURAL GEOLOGY and HYDROLOGY.

DATA PROCESSING (Appendix F, Table 83): Both graduates and employers agreed that knowledge of FORTRAN and BASIC was either desirable or essential for an electronic technician. BASIC, however, received more support from the employers with 50 percent responding ESSENTIAL to BASIC. The percentages of graduates responding ESSENTIAL were approximately the same for FORTRAN and BASIC.

The responses of the combined group reflected the agreement between employers and graduates on the need for both items with over 75 percent of the combined group's responses falling on the needed end of the continuum.

Of the 4 graduates who added information under this topic, 2 listed a knowledge of basic programming concepts. The remaining respondents added COBOL and PL/1.

ALGEBRA (Appendix F, Table 84): There was a consensus among the respondents in the combined group that all but one of the 14 items under ALGEBRA were essential knowledge for an electronic technician. The exception, SERIES; EXPANSIONS, had 46 percent of the respondents in the ESSENTIAL response category.

Graduates were more adamant in their responses with at least 60 percent of the graduates responding ESSENTIAL to all items. Employers agreed with graduates in that over 70 percent of the employers responded on the needed end of the continuum on all items. Employers were less adamant however, in their support of 6 items, DETERMINANTS AND MATRICES, QUADRATIC EQUATIONS, COMPLEX AND IMAGINARY NUMBERS, INEQUALITIES, PROGRESSIONS, and

SERIES; EXPANSIONS, which had less than 50 percent of responses falling in the ESSENTIAL response category.

TRIGONOMETRY (Appendix F, Table 85): Approximately three-fourths of all employers and graduates indicated that knowledge of ANGLES, TRIGONOMETRIC FUNCTIONS and RIGHT TRIANGLES was essential for an electronic technician in performing job duties. The responses of employers and graduates to OBLIQUE TRIANGLES, GRAPHS OF TRIG FUNCTIONS, and INVERSE TRIG FUNCTIONS varied with over 50 percent of the graduates responding ESSENTIAL as compared to over 50 percent of the employers responding DESIRABLE. Approximately 86 percent of the combined group's responses were on the needed end of the continuum.

LOGARITHMS (Appendix F, Table 86): Graduates as a group were adamant in their support of the study of LOGARITHMS with 80 percent responding ESSENTIAL to EXPONENTIAL AND LOG FUNCTIONS and 65 percent responding ESSENTIAL to LOGS OF TRIG FUNCTIONS. Employers agreed with graduates on these items; however, their responses were less supportive with 50 percent responding ESSENTIAL to the first item and 40 percent responding ESSENTIAL to the second item. There was a consensus among respondents in the combined group that knowledge of both items was essential to electronic technicians in performing job duties.

GEOMETRY (Appendix F, Table 87): At least 80 percent of each group's response to PLANE GEOMETRY was on the needed end of the continuum. Responses on this end of the continuum were divided between the ESSENTIAL and the DESIRABLE response categories for each group.

ANALYTIC GEOMETRY (Appendix F, Table 88): Employers and graduates differed significantly (.05 level) on 3 of the 4 items listed under ANALYTIC GEOMETRY. Fifty percent of the employers contributed to the significant difference by responding DESIRABLE to SOLVING EQUATIONS GRAPHICALLY, GRAPHS OF LOG FUNCTIONS and POLAR COORDINATES, while 60 percent or more of the graduates

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responded ESSENTIAL. The remaining item, RECTANGULAR COORDINATES, received more support from the employers with 40 percent responding ESSENTIAL. Seventy percent of the graduates responded similarly to this item. The responses of the combined group reflected the support given these items by employers and graduates with approximately 80 percent of the responses to each item falling on the needed end of the continuum.

CALCULUS (Appendix F, Table 89): Graduates responded favorably to a study of the 5 items listed under CALCULUS. At least 75 percent of the graduates responded on the needed end of the continuum to DIFFERENTIATION, INTEGRATION, DIFFERENTIATION OF FUNCTIONS, DIFFERENTIAL EQUATIONS, and LAPLACE TRANSFORMS. Employers, on the other hand, significantly differed (.05 level) with graduates on 3 items: DIFFERENTIATION OF FUNCTIONS, DIFFERENTIAL EQUATIONS, LAPLACE TRANSFORMS. The difference could be attributed to the 50 percent or more employers who responded NOT NEEDED to the 3 items.

STATISTICS (Appendix F, Table 90): There was a consensus among the group of employers and the group of graduates that a knowledge of the 5 items listed under STATISTICS was either desirable or essential. A review of the response pattern for each item revealed that no more than 50 percent of the responses fell under any one response category. As a result, the respondents appeared divided between the ESSENTIAL and DESIRABLE response categories.

Industrial Engineering Technology

MECHANICS (Appendix G, Table 91): The combined group and the group of graduates agreed by responding on the needed end of the continuum to the 5 items listed under MECHANICS. One item, DYNAMICS, received over 50 percent of both groups' responses in the ESSENTIAL response category. On the other hand, a majority of the employers disagreed with the other groups by responding NOT NEEDED to FLUID MECHANICS and STRENGTH OF MATERIALS.

FUNDAMENTALS OF ELECTRICITY/ELECTRONICS (Appendix G, Table 92): In general, respondents in the 3 groups agreed that a knowledge of the 7 items listed under this topic was at least desirable for an industrial engineering technician in performing job duties. Employers were more adamant in their support of 3 items, A.C. ELECTRICITY, D.C. ELECTRICITY, and ELECTRICAL DEVICES, with at least two-thirds of this group checking the ESSENTIAL response category. On the other hand, three-fourths of the graduates who responded checked the DESIRABLE response category on all items.

LIGHT (Appendix G, Table 93): Employers as a group could not agree on the items listed under this topic as evidenced by the equal number of responses in each category for each item. There was a consensus on all items among the graduates who responded. Seventy-five percent of this group checked the NOT NEEDED category on all but the first item. On this item, GENERAL THEORY OF LIGHT, 75 percent of the graduates checked the DESIRABLE response category.

In general, only a knowledge of the GENERAL THEORY of LIGHT is needed by an industrial engineering technician in performing job duties.

SOUND (Appendix G, Table 94): There was a consensus among respondents in the 3 groups that knowledge of the items listed under SOUND was not needed by industrial engineering technicians in performing job duties.

HEAT (Appendix G, Table 95): At least 75 percent of the respondents in each group responded on the needed end of the continuum to each item listed under HEAT. Employers were more adamant in their support of the GENERAL THEORY of HEAT and HEAT TRANSFER as two-thirds checked the ESSENTIAL response category. A majority of the graduates, on the other hand, checked the DESIRABLE response category for each of the 3 items.

MODERN PHYSICS (Appendix G, Table 96): Over two-thirds of respondents in the 3 groups checked the NOT NEEDED response category for RELATIVITY and FISSION, FUSION, RADIOACTIVITY. However, there was a consensus among the respondents in the combined group and the group of graduates that knowledge of the STRUCTURE OF THE ATOM was at least desirable for an industrial engineering technician.

CHEMISTRY (Appendix G, Table 97): A majority of the employers responded on the needed end of the continuum to all items listed under the topic CHEMISTRY. Graduates, on the other hand, responded on this end of the continuum to only one item, GENERAL CHEMISTRY. In general, the combined group supported the study of only 2 items, GENERAL CHEMISTRY and PHYSICAL CHEMISTRY.

BIOLOGY (Appendix G, Table 98): A majority of the respondents in the combined group and the group of graduates agreed that knowledge of the 6 items listed under BIOLOGY was not needed by industrial engineering technicians in performing their job duties. The group of employers consistently differed with the other groups by two-thirds responding on the needed end of the continuum to all items.

GEOLOGY (Appendix G, Table 99): There was a consensus among respondents in each group that knowledge of the items listed under GEOLOGY is not needed by industrial engineering technicians in performing job duties.

DATA PROCESSING (Appendix G, Table 100): In general, the combined group supported the study of both FORTRAN and BASIC programming languages. Fifty percent of this group checked the DESIRABLE response category while another 16 percent responded in the ESSENTIAL category. Graduates agreed with the combined group by a majority responding on the needed end of the continuum. Employers, on the other hand, were equally divided between the ESSENTIAL and the NOT NEEDED response categories on both items.

One graduate added COBOL to the 2 items under this topic.

ALGEBRA (Appendix G, Table 101): Over two-thirds of the employers agreed that the items listed under ALGEBRA were essential for an industrial engineering technician. Fifty percent of the graduates, on the other hand, checked NOT NEEDED for 2 items, DETERMINANTS AND MATRICES and SERIES; EXPANSIONS. In general, the combined group agreed with the employers on all items but DETERMINANTS AND MATRICES, COMPLEX AND IMAGINARY NUMBERS, INEQUALITIES, and SERIES; EXPANSIONS. A majority of the combined group did respond on the needed end of the continuum to these exceptions.

TRIGONOMETRY (Appendix G, Table 102): Employers and the combined group agreed that the items listed under TRIGONOMETRY were essential. The employers were unanimous in the selection of this response category. Graduates differed with the other groups by a majority checking the DESIRABLE category for GRAPHS OF TRIG FUNCTIONS and INVERSE TRIG FUNCTIONS.

LOGARITHMS (Appendix G, Table 103): Employers were unanimous in their responses to the 2 items listed under LOGARITHMS. One hundred percent of this group checked ESSENTIAL to these items. A majority of the graduates, on the other hand, selected the DESIRABLE category. Only 25 percent of the graduates agreed with their employers.

GEOMETRY (Appendix G, Table 104): The majority of employer respondents indicated that these items were essential, while graduates were evenly divided between the ESSENTIAL and DESIRABLE categories.

The consensus of opinion of the combined group was that both items represent essential information.

ANALYTIC GEOMETRY (Appendix G, Table 105): Two-thirds of the employers responded that each of these items was essential, while the remaining responses were under the DESIRABLE category. One-half of the graduates agreed that the first item, RECTANGULAR COORDINATES, was essential while half of this group decided that the remaining items were not needed.

CALCULUS (Appendix G, Table 106): Two-thirds of all employers responded that the items listed under CALCULUS were essential, while the remainder indicated they were not needed. The majority of the graduates selected the DESIRABLE category for each item except LAPLACE TRANSFORMS, which 50 percent checked NOT NEEDED.

STATISTICS (Appendix G, Table 107): Employers overwhelmingly endorsed each of these items as essential. Only 25 percent of the graduates concurred with that response. However, 50 percent or more of this group selected the DESIRABLE category in every case.

Analysis of Responses to the Open-ended Statement

At the end of the questionnaire, the study participants were asked to respond to the following open-ended statement:

> COMMENTS: The space below is reserved for any other comments you may have pertaining to this study. For example, you may wish to be more specific with regard to certain topics that you feel to be too general, or you may think of other topics that should be included.

For analysis and discussion purposes, the responses to the open-ended statement will be presented by Engineering Technology field. The diversity of the responses do not lend themselves to a tabular presentation.

Architectural Technology

Nine out of the 16 responding graduates added comments concerning the survey. In general, comments were related to the specific architectural skills and knowledge needed by an architectural technician as opposed to basic science and mathematics topics. For example, 2 respondents mentioned the need for model building while a third suggested computer graphics. Other respondents offering comments mentioned a need for more design theory, engineering economics and a knowledge of mechanical and electrical systems layout. Two responses, however, were related to the purpose of the study. One graduate indicated that "a good background in math is essential" while "calculus is not as widely used." Another commented that "solar energy is rapidly becoming a specialized field and should be given prompt attention" in an architectural technology program.

The one employer who offered a comment indicated that a mastery of drawing tools and techniques, drafting in all media, and the ability to read all types of drawings were important for an architectural technician in performing job duties.

Chemical Technology

The employer and the 2 graduates who added comments agreed that chemical technicians need a background in routine laboratory procedures and the use of instrumentation. The comments did reflect, however, that a sound background in general and analytical chemistry was fundamental for a chemical technician.

Civil Engineering Technology

Forty-one percent of the 51 responding graduates added comments. The most frequently mentioned topic was mathematics. Five graduates specifically commented that knowledge of mathematics such as algebra, trigonometry, and geometry was essential for a civil technician in performing his duties. Also evident in the comments was an interest in those basic mathematics and science topics which lead to a better understanding of such areas as sanitation, soils, concrete, asphalt, hydraulics, and surveying. In general, graduates' comments were supportive of the study of basic science and mathematics topics.

The four employers, on the other hand, indicated more interest in topics which are directly related to their business. For example, two employers stressed the need for surveying while a third indicated an interest in the study of graphic art.

Computer Technology

Both the employers' and graduates' comments were general in nature. However, both groups, each numbering three respondents, mentioned the importance of mathematics to a computer technician. The following comment of one employer illustrates the interest in basic science and mathematics:

> The people I hire must not only have knowledge but must
> be able to think. Strong analytic ability is a must.

Electronic Engineering Technology

Employers did not comment on the questionnaire; however, 8 of the 20 graduates did respond to the open-ended statement. In general, these graduates addressed topics related to their specific jobs. Comments ranged from the need for more digital electronics to the desirability of courses in quality control. Underlying all the graduates' comments appeared to be an awareness of the rapidly changing requirements of the electronics field and an appreciation of the value of basic science and mathematics in keeping abreast of these changes.

Industrial Engineering Technology

Of the two graduates who added comments, one stressed the importance of the study of physical science topics such as light and sound. Also, the study of trigonometry, algebra and geometry was stressed by this respondent. The second graduate indicated that a knowledge of engineering economy was important for an industrial engineering technician.

Employers returned no comments on their questionnaires.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The major purposes of this study were to determine the attitudes of the graduates of Wake Technical Institute's 6 Engineering Technology Programs and the employers of these graduates concerning the basic science and mathematics topics most needed by engineering technicians in performing their duties. Another purpose of this study was to obtain comments from respondents concerning topics other than those listed on the survey which are needed by engineering technicians in performing their duties.

A questionnaire to determine the basic science and mathematics topics most needed by engineering technicians in performing their duties was developed and mailed to 697 participants. Of this total, 470 were graduates of one of the 6 Engineering Technology programs at Wake Technical Institute who received degrees during the period from 1969 through 1977 and 227 were employers of Wake Technical Institute graduates of these programs.

Two groups were selected as jurors for the purpose of evaluating and editing the first draft of the questionnaire. One group consisted of a faculty committee comprised of department heads from the Architectural Technology, Chemical Technology, Civil Engineering Technology, Computer Technology, Electronic Engineering Technology, Industrial Engineering Technology departments and an instructor from the Mathematics and Physics Department. A second group of jurors was selected on their present involvement with two and four-year Engineering Technology programs nationwide.

On the basis of the recommendations made by the 2 groups of jurors, 81 items under 17 topics and one open-ended statement were included in the questionnaire.

A Chi Square analysis was used to test 6 null hypotheses to determine whether significant differences in responses existed between graduates and employers of graduates from each of the 6 Engineering Technology programs. In the Chi Square analysis, the null hypothesis of no significant difference was rejected when observed differences between graduates and employers of the graduates of a given program would have been expected to occur by chance fewer than 5 times in 100 similar samples.

Responses to an open-ended statement were analyzed and the information summarized by Engineering Technology field.

Testing of the 6 null hypotheses for all of the 80 items resulted in 480 Chi Square analyses. Significant differences in responses at the .05 level or better were observed on 57, or approximately 12 percent, of the comparisons. The extent to which significant differences were observed between groups was as follows:

1. Architectural Technology graduates differed with the employers on 20 percent of the items;
2. Chemical Technology graduates differed with their employers on 8 percent of the items;
3. Civil Engineering Technology graduates differed with their employers on 16 percent of the items;
4. Computer Technology graduates differed with their employers on 16 percent of the items;
5. Electronic Engineering Technology graduates differed with their employers on 10 percent of the items; and
6. Industrial Engineering Technology graduates differed with their employers on only 1 percent of the items.

Significant differences existed between the responses of the 6 pairs of respondents on 38 items as follows:

1. One of the 6 paired groups of employers and graduates differed significantly on the following items: PROPERTIES OF MATERIALS, ELECTRIC FIELDS, MAGNETIC FIELDS, ELECTROMAGNETICS, GENERAL THEORY OF HEAT, HEAT TRANSFER, QUANTITATIVE CHEMISTRY, PHYSICAL CHEMISTRY, MICROBIOLOGY, ECONOMIC GEOLOGY, STRUCTURAL GEOLOGY, GEOPHYSICS, HYDROLOGY, INEQUALITIES, PROGRESSIONS, SERIES, EXPANSIONS, TRIGONOMETRIC FUNCTIONS, INVERSE TRIG FUNCTIONS, PLANE GEOMETRY, SOLID GEOMETRY, SOLVING EQUATIONS GRAPHICALLY, GRAPHS OF LOG FUNCTIONS, POLAR COORDINATES, PROBABILITY, SAMPLING THEORY, AND HYPOTHESIS TESTING.
2. Two of the 6 paired groups of employers and graduates differed significantly on the following items: GENERAL THEORY OF LIGHT, RELATIVITY, EXPONENTIAL AND LOG FUNCTIONS, POLAR COORDINATES, DIFFERENTIATION, INTEGRATION, LAPLACE TRANSFORMS, FREQUENCY DISTRIBUTION, and VARIABILITY.
3. Three of the 6 paired groups of employers and graduates differed significantly on the following items: RECEPTION AND TRANSMISSION OF SOUND and RELATIVITY.
4. Four of the 6 paired groups of employers and graduates differed significantly on the following items: DIFFERENTIATION OF FUNCTIONS and DIFFERENTIAL EQUATIONS.

Frequency of responses by response category was analyzed by Engineering Technology field. For summary purposes, Table 5 lists the basic science and mathematics topics needed by engineering technicians as determined by this study. An "E" in the table indicates that the item is essential knowledge for a technician in the Engineering Technology field listed in the column. Similarly, an "X" in the table indicates that knowledge of the item is desirable but not essential. Items which this study has determined are not needed are indicated by a dash "-". The three designations, E, X, -, are based on response patterns for a given item in which at least the group of employers or the group of graduates agreed with the combined group by a majority response in either ESSENTIAL, DESIRABLE or NOT NEEDED categories.

The need for the items listed under the 17 topics varied as summarized below:

1. The strongest support for the items under MECHANICS came from respondents in the Architectural, Chemical, Civil Engineering, and Industrial Engineering technologies.
2. The items under the FUNDAMENTALS OF ELECTRICITY/ELECTRONICS were unanimously supported by respondents in the Computer, Electronic Engineering, and Industrial Engineering technologies.
3. All groups of respondents supported the study of the GENERAL THEORY OF LIGHT; however, only the Electronic Engineering Technology respondents indicated support for all the items under LIGHT.
4. The study of the items under SOUND was supported by three groups of respondents: Architectural, Computer, and Electronic Engineering technologies.
5. All groups of respondents supported the study of HEAT.
6. MODERN PHYSICS was important only to responding chemical technicians and electronic engineering technicians.
7. Only the Chemical Technology respondents supported the study of the items under CHEMISTRY.
8. Items listed under BIOLOGY were needed only by chemical technicians.
9. Civil engineering technicians were the only technicians who need a knowledge of all the items under GEOLOGY.

10. The 2 items under DATA PROCESSING were important to all but architectural technicians.

11. The study of ALGEBRA, TRIGONOMETRY, LOGARITHMS, GEOMETRY, ANALYTIC GEOMETRY, and CALCULUS was supported by all respondents.

12. The Chemical, Civil Engineering, Electronic Engineering, and Industrial Engineering technology respondents indicated support for the items under STATISTICS.

At the end of the questionnaire, the study participants were given the opportunity to complete the following statement:

> COMMENTS: The space below is reserved for any other comments you may have pertaining to this study. For example, you may wish to be more specific with regard to certain topics that you feel to be too general; or you may think of other topics that should be included.

In general, respondents' comments addressed changing skills and knowledge required by the technician to produce in his job. However, the respondents' comments did reflect an awareness of the rapidly changing requirements in the Engineering Technology field and an appreciation of the value of basic science and mathematics in keeping abreast of these changes.

Conclusions

The findings of this study warrant the following conclusions:

1. Graduates and employers in all 6 Engineering Technology fields indicated that a knowledge of mathematics topics ranging from Algebra to Calculus was important for an engineering technician. The extent to which a certain mathematical topic was important depended upon its direct usefulness in solving day-to-day problems on the job. Support for the study of other mathematical topics resulted from a need for a foundation in mathematics which would afford the technician an opportunity to keep abreast of technological changes as well as to develop analytical skills.

2. The participants believed that an engineering technician needed a knowledge of basic science topics which provide a foundation for the application of the skills and knowledge in their particular field. For example, chemical technicians indicated support for a study of the basic science of chemistry. Electronic technicians, on the other hand, indicated an interest in the fundamentals of electricity and electronics which explain the electrical phenomena associated with the applications of electronics and electricity.
3. For the topic DATA PROCESSING, all study participants except those in Architectural Technology believed that a knowledge of at least one scientific programming language was important. In addition, respondents indicated an interest in the study of COBOL.
4. Based on the response patterns of employers and graduates, graduates' responses were more supportive of a knowledge of basic science and mathematics topics. Employers, on the other hand, tended to support only those topics which were immediately useful in solving day-to-day problems. This difference in response patterns can be attributed to the engineering technicians' desire to stay abreast of technological change while employers appear interested primarily in the knowledge and skills which contribute to immediate production.

Recommendations for Further Study

The general conclusion that employers and graduates perceive a need for a knowledge of basic science and mathematics topics suggests that formal education programs should meet this need. Institutes such as Wake Technical Institute which are offering Engineering Technology programs can, by incorporating the feedback from employers and graduates, design curriculums to meet the need of the Engineering Technology field. Therefore, the results of this study can be used by Wake Technical Institute's Engineering Technology departments specifically and Engineering Technology educators in general in reviewing the basic science and mathematics content of their curriculums. Given the limitations of time in a two-year Engineering Technology program and the importance of relevant subject matter, curriculums could be revised to better prepare engineering technicians to perform job duties, as well as keep abreast of the rapidly changing fields of technology.

Table 5 Summary of Basic Science and Mathematics Topics Most Needed by Engineering Technicians

	Architectural Technology	Chemical Technology	Civil Engineering Technology	Computer Technology	Electronic Engineering Technology	Industrial Engineering Technology
MECHANICS						
Statics	X	X	E	-	X	X
Fluid Mechanics	X	X	X	-	-	X
Properties of Materials	E	E	E	-	X	X
Strength of Materials	E	-	E	-	-	X
Dynamics	X	X	X	X	X	E
FUNDAMENTALS OF ELECTRICITY/ELECTRONICS						
Electric Fields	-	-	-	E	E	X
Magnetic Fields	-	-	-	E	E	X
D. C. Electricity	X	X	X	E	E	X
A. C. Electricity	X	X	X	E	E	X
Electronics	-	-	-	E	E	X
Electrical Devices	X	X	X	E	E	E
Electro-magnetics	-	-	-	X	E	X
LIGHT						
General Theory	X	X	X	X	X	X
Geometrical Optics	-	-	-	X	X	-
Physical Optics	-	X	-	X	X	-
Spectral Analysis	-	X	-	-	X	-

Table 5 Summary of Basic Science and Mathematics Topics Most Needed by Engineering Technicians

	Architectural Technology	Chemical Technology	Civil Engineering Technology	Computer Technology	Electronic Engineering Technology	Industrial Engineering Technology
SOUND						
General Theory	X	X	-	X	X	-
Reception/ Transmission	X	-	-	X	X	-
HEAT						
General Theory	X	E	X	X	X	X
Heat Transfer	X	X	X	X	X	E
Thermo-dynamics	X	E	X	-	X	X
MODERN PHYSICS						
Structure of Atom	-	E	-	-	X	X
Relativity	-	X	-	-	X	-
Fission/Fusion Radioactivity	-	E	-	-	X	-
CHEMISTRY						
General Chemistry	-	E	X	-	X	X
Qualitative Chemistry	-	E	-	-	-	-
Quantitative Chemistry	-	E	-	-	-	-
Physical Chemistry	-	E	-	-	-	X
Organic Chemistry	-	E	-	-	-	-

Table 5 Summary of Basic Science and Mathematics Topics Most Needed by Engineering Technicians

	Architectural Technology	Chemical Technology	Civil Engineering Technology	Computer Technology	Electronic Engineering Technology	Industrial Engineering Technology
BIOLOGY						
General Biology	-	X	-	-	-	-
Micro-biology	-	E	-	-	-	-
Ecology	X	X	-	-	-	-
Botany	-	-	-	-	-	-
Zoology	-	-	-	-	-	-
Genetics	-	-	-	-	-	-
GEOLOGY						
Physical Geology	X	-	X	-	-	-
Economic Geology	-	X	X	-	-	-
Structural Geology	-	-	X	-	-	-
Geophysics	-	-	X	-	-	-
Hydrology	X	-	E	-	-	-
DATA PROCESSING						
FORTRAN	-	X	X	X	X	X
BASIC	-	X	X	X	X	X
ALGEBRA						
Exponents/ Radicals	X	E	E	E	E	E
Scientific Notation	X	E	E	E	E	E
Algebraic Expressions	E	E	E	E	E	E
Equations/ Word Problems	E	E	E	E	E	E

Table 5 Summary of Basic Science and Mathematics Topics Most Needed by Engineering Technicians

	Architectural Technology	Chemical Technology	Civil Engineering Technology	Computer Technology	Electronic Engineering Technology	Industrial Engineering Technology
ALGEBRA (con't)						
Determinants and Matrices	X	X	E	X	E	X
Solutions to Systems Equations	E	E	E	X	E	E
Factoring	X	E	E	X	E	E
Fractions	E	E	E	E	E	E
Quadratic Equations	X	E	E	X	E	E
Complex and Imaginary Numbers	X	X	X	X	E	X
Inequalities	X	X	X	X	E	X
Ratio and Proportion	E	E	E	E	E	E
Progressions	X	X	E	X	E	E
Series; Expansions	X	X	X	X	X	X
TRIGONOMETRY						
Angles	E	E	E	X	E	E
Trigonometric Functions	E	E	E	X	E	E
Right Triangles	E	E	E	X	E	E
Oblique Triangles	E	E	E	X	E	E
Graphs of Trig Functions	E	E	E	X	E	E
Inverse Trig Functions	X	X	E	X	X	E

Table 5 Summary of Basic Science and Mathematics Topics Nost Needed by Engineering Technicians

	Architectural Engineering	Chemical Technology	Civil Engineering Technology	Computer Technology	Electronic Engineering Technology	Industrial Engineering Technology
LOGARITHMS						
Exponential and Log Functions	X	X	X	X	E	E
Logs of Trig Functions	X	X	X	X	E	E
GEOMETRY						
Plane Geometry	E	X	E	X	X	E
Solid Geometry	E	X	E	X	X	E
ANALYTIC GEOMETRY						
Rectangular Coordinates	E	X	E	X	E	E
Solving Equations Graphically	X	X	E	X	E	X
Graphs of Log Functions	X	X	X	X	X	X
Polar Coordinates	X	X	E	X	X	X
CALCULUS						
Differentiation	X	E	E	X	X	X
Integration	X	E	E	X	X	X
Differentiation of Functions	X	X	X	X	X	X
Differential Equations	X	X	X	X	X	X
Laplace Transforms	-	-	X	-	X	X

Table 5 Summary of Basic Science and Mathematics Topics Most Needed by Engineering Technicians

	Architectural Engineering	Chemical Technology	Civil Engineering Technology	Computer Technology	Electronic Engineering Technology	Industrial Engineering Technology
STATISTICS						
Probability	-	X	X	-	X	E
Frequency Distributions	-	X	X	-	X	E
Variability	-	X	X	-	X	E
Sampling Theory	-	X	X	-	X	E
Hypothesis Testing	-	X	X	X	X	X

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APPENDIX A

QUESTIONNAIRE

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AN ASSESSMENT OF BASIC SCIENCE AND MATHEMATICS KNOWLEDGE NEEDED IN SELECTED ENGINEERING TECHNICIAN FIELDS

INSTRUCTIONS:

This survey is designed to identify the basic science and mathematics topics most needed by engineering technicians in performing their duties. The topics listed in this survey are potential subjects for a two-year engineering technology curriculum. You are asked to evaluate the importance of the mathematics and science topics in this survey according to the following definitions. Please circle the number beside each item which indicates what you feel to be the most appropriate response.

"1" means - essential knowledge for adequate performance in this field of technology.

"2" means - desirable knowledge, but not essential to the performance of job duties in this field. ("Desirable" indicates that this knowledge would be helpful in certain related areas in which technicians may become involved, either through changes in job duties or as a result of advances in technology which you can foresee.)

"3" means - knowledge that is not needed in performing the duties of an engineering technician in this field.

Please circle the letter beside the engineering technician field for which you are responding.

A. Architectural Technology
B. Chemical Technology
C. Civil Engineering Technology
D. Computer Technology
E. Electronic Engineering Technology
F. Industrial Engineering Technology
G. Other (Please specify)__________________________________

TOPICS

A. Mechanics

1 2 3 1. Statics (vectors and forces, equilibrium, torque, distributed loads, trusses, fluid statics - pressure, density, buoyancy)

1 2 3 2. Fluid mechanics (fluid flow, pressure losses, piping systems)

1 2 3 3. Structure, properties and fabrication of materials (metallurgy, chemical bonds, energy levels; properties of metals, plastics, soils, concrete, wood; testing, heat treating, forming)

1 2 3 4. Strength of materials (stress-strain relationships, moments, beam deflection)

1 2 3 5. Dynamics (friction, work, energy, equations of motion, velocity, acceleration, rotational motion)

B. Fundamentals of Electricity/Electronics

1 2 3 1. Electric fields, to include the nature of capacitance

1 2 3 2. Magnetic fields, to include the nature of inductance

1 2 3 3. D. C. electricity (current, voltage, resistance, power)

1 2 3 4. A. C. electricity (effective values, impedance, resonance, power)

1 2 3 5. Electronics (semi-conductors, transistors, circuits)

1 2 3 6. Electrical devices (motors, generators, transformers)

1 2 3 7. Electromagnetics (Maxwell's Hypothesis, electromagnetic waves, Poynting Vectors)

C. Light

1 2 3 1. General theory (waves, reflection, refraction)

1 2 3 2. Geometrical optics (lenses and mirrors)

1 2 3 3. Physical optics (interference, diffraction, polarization, dispersion, lasers)

1 2 3 4. Spectral analysis

D. Sound

1 2 3 1. General theory (waves, oscillations, vibrations, superposition)

1 2 3 2. Reception and transmission (radiation, scattering, absorption, damping)

E. Heat

1 2 3 1. General theory (temperature, specific heat, ideal gas laws)

1 2 3 2. Heat transfer (conduction, convection, radiation)

1 2 3 3. Thermodynamics (basic laws, energy cycles, gas laws, entropy)

"1" - Essential "2" - Desirable "3" - Not Needed

F. Modern Physics

1 2 3 1. Structure of the atom

1 2 3 2. Relativity and quantum theory

1 2 3 3. Fission, fusion, and radioactivity

G. Chemistry

1 2 3 1. General chemistry (atomic structure, periodic table, basic reactions, oxidation-reduction equations, equivalent weights, chemical bonds, compounds)

1 2 3 2. Qualitative chemistry (solutions, ionic species)

1 2 3 3. Quantitative chemistry (volumetric analysis of acids and bases; neutralization filtration, stoichiometry, gravimetric analysis; instrumental methods)

1 2 3 4. Physical chemistry (atomic theory, chemical thermodynamics, electrochemistry, photochemistry)

1 2 3 5. Organic chemistry (hydrocarbons, compounds of carbon)

H. Biology

1 2 3 1. General biology (species formation, evolution, cellular structure, functioning of organisms)

1 2 3 2. Microbiology (micro-organisms, biochemistry, water and waste treatment)

1 2 3 3. Ecology (man and nature; ecosystems)

1 2 3 4. Botany (plant biology)

1 2 3 5. Zoology (animal biology)

1 2 3 6. Genetics (effects of heredity; reproduction, population genetics)

I. Geology

1 2 3 1. Physical geology (overall study of the earth with stress on dynamic and structural aspects; landscape development, mountains, composition of rocks and minerals)

1 2 3 2. Economic geology (search for and exploitation of mineral resources such as metallic ores, fuels, and water)

1 2 3 3. Structural geology (earth structures and relationships to forces which produce the structures)

1 2 3 4. Geophysics (earthquakes, methods of mineral exploration)

1 2 3 5. Hydrology (science of water cycle; runoff, drainage)

"1" - Essential "2" - Desirable "3" - Not Needed

J. Data Processing

1 2 3 1. FORTRAN

1 2 3 2. BASIC

3. Other (List)

1 2 3 a.______________________________

1 2 3 b.______________________________

1 2 3 c.______________________________

K. Algebra

1 2 3 1. Exponents and radicals

1 2 3 2. Scientific notation

1 2 3 3. Algebraic expressions - addition, subtraction, multiplication, division

1 2 3 4. Solution of equations and word problems

1 2 3 5. Determinants and matrices - use in solving systems of linear equations

1 2 3 6. Algebraic solutions to systems of equations

1 2 3 7. Factoring

1 2 3 8. Fractions - addition, subtraction, multiplication, division

1 2 3 9. Solution of quadratic equations ($ax^2 + bx + c = 0$)

1 2 3 10. Complex, or imaginary, numbers

1 2 3 11. Inequalities

1 2 3 12. Ratio and proportion

1 2 3 13. Progressions - arithmetic and geometric

1 2 3 14. Series; expansion of functions

L. Trigonometry

1 2 3 1. Angles (degrees and radians)

1 2 3 2. Trigonometric functions

1 2 3 3. Applications of right triangles

1 2 3 4. Oblique triangles; law of sines and law of cosines

1 2 3 5. Graphs of trigonometric functions

1 2 3 6. Inverse trigonometric functions

M. Logarithms

1 2 3 1. Exponential and logarithmic functions and equations

1 2 3 2. Logarithms of trigonometric functions

N. Geometry - Figures and Formulas

1 2 3 1. Plane geometry - properties and relations of two-dimensional shapes

1 2 3 2. Solid geometry - three dimensional shapes

O. Analytic Geometry

1 2 3 1. Rectangular Coordinates

1 2 3 2. Solving equations and systems of equations graphically

1 2 3 3. Graphs of logarithmic functions

1 2 3 4. Polar coordinates

P. Calculus

1 2 3 1. Differentiation (slopes, rates)

1 2 3 2. Integration (areas under curves, volumes)

1 2 3 3. Differentiation of trigonometric functions and of logarithms

1 2 3 4. Differential equations

1 2 3 5. Laplace transforms

Q. Statistics

1 2 3 1. Probability

1 2 3 2. Frequency distributions

1 2 3 3. Variability (standard deviations, arithmetic mean)

1 2 3 4. Sampling theory

1 2 3 5. Hypothesis testing

COMMENTS: The space below is reserved for any other comments you may have pertaining to this study. For example, you may wish to be more specific with regard to certain topics that you feel to be too general; or you may think of other topics that should be included.

Appendix B

Architectural Technology Tables

Table 6 Mechanics (Items A.1. - A.5.)
Architectural Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES Essential %	Desirable %	Not Needed %	Total N
Statics	Employers	28.57	64.29	7.14	14
	Graduates	56.25	37.50	6.25	16
	Combined	43.33	50.00	6.67	30
Fluid Mechanics	Employers	7.14	35.71	57.14	14
	Graduates	18.75	43.75	37.50	16
	Combined	13.33	40.00	46.67	30
Properties of Materials	Employers	35.71	64.29	0.00	14
	Graduates	75.00	18.75	6.25	16
	Combined	56.67	40.00	3.33	30
Strength of Materials	Employers	42.86	50.00	7.14	14
	Graduates	62.50	25.00	12.50	16
	Combined	53.33	36.67	10.00	30
Dynamics	Employers	0.00	50.00	50.00	14
	Graduates	25.00	37.50	37.50	16
	Combined	13.33	43.33	43.33	30

Table 7 Fundamentals of Electricity/Electronics (Items B.1.-B.7.)
Architectural Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Electric Fields	Employers	0.00	21.43	78.57	14
	Graduates	12.50	37.50	50.00	16
	Combined	6.67	30.00	63.33	30
Magnetic Fields	Employers	0.00	21.43	78.57	14
	Graduates	12.50	31.25	56.25	16
	Combined	6.67	26.67	66.67	30
D. C. Electricity	Employers	0.00	35.71	64.29	14
	Graduates	12.50	50.00	37.50	16
	Combined	6.67	43.33	50.00	30
A. C. Electricity	Employers	7.14	57.14	35.71	14
	Graduates	18.75	56.25	25.00	16
	Combined	13.33	56.67	30.00	30
Electronics	Employers	0.00	7.14	92.86	14
	Graduates	6.25	37.50	56.25	16
	Combined	3.33	23.33	73.33	30
Electrical Devices	Employers	7.14	50.00	42.86	14
	Graduates	18.75	50.00	31.25	16
	Combined	13.33	50.00	36.67	30
Electromagnetics	Employers	0.00	7.14	92.86	14
	Graduates	6.67	26.67	66.67	15
	Combined	3.45	17.24	79.31	29

Table 8 Light (Items C.1. - C.4.)
Architectural Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES Essential %	Desirable %	Not Needed %	Total N
General Theory	Employers	21.43	42.86	35.71	14
	Graduates	25.00	37.50	37.50	16
	Combined	23.33	40.00	36.67	30
Geometrical Optics	Employers	0.00	28.57	71.43	14
	Graduates	12.50	43.75	43.75	16
	Combined	6.67	36.67	56.67	30
Physical Optics	Employers	0.00	28.57	71.43	14
	Graduates	0.00	43.75	56.25	16
	Combined	0.00	36.67	63.33	30
Spectral Analysis	Employers	0.00	0.00	100.00	14
	Graduates	12.50	18.75	68.75	16
	Combined	6.67	10.00	83.33	30

Table 9 Sound (Items D.1. - D.2.)
Architectural Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
General Theory	Employers	14.29	57.14	28.57	14
	Graduates	18.75	56.25	25.00	16
	Combined	16.67	56.67	26.67	30
Reception and Transmission	Employers	0.00	35.71	64.29	14
	Graduates	18.75	62.50	18.75	16
	Combined	10.00	50.00	40.00	30

Table 10 Heat (Items E.1. - E.3.)
Architectural Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
General Theory	Employers	42.86	28.57	28.57	14
	Graduates	31.25	37.50	31.25	16
	Combined	36.67	33.33	30.00	30
Heat Transfer	Employers	28.57	50.00	21.43	14
	Graduates	50.00	50.00	0.00	16
	Combined	40.00	50.00	10.00	30
Thermo-dynamics	Employers	7.14	42.86	50.00	14
	Graduates	25.00	31.25	43.75	16
	Combined	16.67	36.67	46.67	30

Table 11 Modern Physics (Items F.1. - F.3.)
Architectural Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Structure of Atom	Employers	0.00	0.00	100.00	14
	Graduates	6.25	25.00	68.75	16
	Combined	3.33	13.33	83.33	30
Relativity	Employers	0.00	0.00	100.00	14
	Graduates	6.25	31.25	62.50	16
	Combined	3.33	16.67	80.00	30
Fission, Fusion, Radioactivity	Employers	0.00	0.00	100.00	14
	Graduates	12.50	18.75	68.75	16
	Combined	6.67	10.00	83.33	30

Table 12 Chemistry (Items G.1. - G.5.)
Architectural Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
General Chemistry	Employers	0.00	28.57	71.43	14
	Graduates	12.50	25.00	62.50	16
	Combined	6.67	26.67	66.67	30
Qualitative Chemistry	Employers	0.00	0.00	100.00	14
	Graduates	6.25	12.50	81.25	16
	Combined	3.33	6.67	90.00	30
Quantitative Chemistry	Employers	0.00	0.00	100.00	14
	Graduates	6.25	18.75	75.00	16
	Combined	3.33	10.00	86.67	30
Physical Chemistry	Employers	0.00	14.29	85.71	14
	Graduates	6.25	31.25	62.50	16
	Combined	3.33	23.33	73.33	30
Organic Chemistry	Employers	0.00	7.14	92.86	14
	Graduates	6.25	18.75	75.00	16
	Combined	3.33	13.33	83.33	30

Table 13 Biology (Items H.1. - H.6.)
Architectural Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES Essential %	Desirable %	Not Needed %	Total N
General Biology	Employers	7.14	14.29	78.57	14
	Graduates	0.00	33.33	66.67	15
	Combined	3.45	24.14	72.41	29
Micro-biology	Employers	0.00	0.00	100.00	14
	Graduates	6.67	33.33	60.00	15
	Combined	3.45	17.24	79.31	29
Ecology	Employers	21.43	28.57	50.00	14
	Graduates	6.25	43.75	50.00	16
	Combined	13.33	36.67	50.00	30
Botany	Employers	0.00	35.71	64.29	14
	Graduates	6.25	31.25	62.50	16
	Combined	3.33	33.33	63.33	30
Zoology	Employers	0.00	14.29	85.71	14
	Graduates	6.25	12.50	81.25	16
	Combined	3.33	13.33	83.33	30
Genetics	Employers	0.00	7.69	92.31	13
	Graduates	6.25	18.75	75.00	16
	Combined	3.45	13.79	82.76	29

Table 14 Geology (Items I.1. - I.5.)
Architectural Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Physical Geology	Employers	7.14	57.14	35.71	14
	Graduates	31.25	62.50	6.25	16
	Combined	20.00	60.00	20.00	30
Economic Geology	Employers	0.00	14.29	85.71	14
	Graduates	12.50	50.00	37.50	16
	Combined	6.67	33.33	60.00	30
Structural Geology	Employers	0.00	21.43	78.57	14
	Graduates	31.25	37.50	31.25	16
	Combined	16.67	30.00	53.33	30
Geophysics	Employers	0.00	21.43	78.57	14
	Graduates	25.00	25.00	50.00	16
	Combined	13.33	23.33	63.33	30
Hydrology	Employers	0.00	71.43	28.57	14
	Graduates	25.00	75.00	0.00	16
	Combined	13.33	73.33	13.33	30

Table 15 Data Processing (Items J.1. - J.2.)
Architectural Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
FORTRAN	Employers	0.00	28.57	71.43	14
	Graduates	21.43	14.29	64.29	14
	Combined	10.71	21.43	67.86	28
BASIC	Employers	7.14	35.71	57.14	14
	Graduates	16.67	33.33	50.00	12
	Combined	11.54	34.62	53.85	26

Table 16 Algebra (Items K.1. - K.14.)
Architectural Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES Essential %	Desirable %	Not Needed %	Total N
Exponents and Radicals	Employers	35.71	42.86	21.43	14
	Graduates	46.67	33.33	20.00	15
	Combined	41.3[illegible]	37.93	20.69	29
Scientific Notation	Employers	28.57	28.57	42.86	14
	Graduates	46.67	40.00	13.33	15
	Combined	37.93	34.48	27.59	29
Algebraic expressions	Employers	50.00	42.86	7.14	14
	Graduates	60.00	26.67	13.33	15
	Combined	55.17	34.48	10.34	29
Equations and Word Problems	Employers	71.43	21.43	7.14	14
	Graduates	66.67	26.67	6.67	15
	Combined	68.97	24.14	6.90	29
Determinants & Matrices	Employers	28.57	57.14	14.29	14
	Graduates	46.67	40.00	13.33	15
	Combined	37.93	48.28	13.79	29
Solutions to systems equations	Employers	42.86	50.00	7.14	14
	Graduates	60.00	26.67	13.33	15
	Combined	51.72	37.93	10.34	29
Factoring	Employers	35.71	42.86	21.43	14
	Graduates	40.00	40.00	20.00	15
	Combined	37.93	41.38	20.69	29
Fractions	Employers	71.43	21.43	7.14	14
	Graduates	86.67	6.67	6.67	15
	Combined	79.31	13.79	6.90	29
Quadratic Equations	Employers	35.71	42.86	21.43	14
	Graduates	46.67	40.00	13.33	15
	Combined	41.38	41.38	17.24	29

Table 16 (con't) Algebra (Items K.1.-K.14.)
Architectural Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Complex & Imaginary Numbers	Employers	14.29	21.43	64.29	14
	Graduates	33.33	40.00	26.67	15
	Combined	24.14	31.03	44.83	29
Inequalities	Employers	21.43	28.57	50.00	14
	Graduates	40.00	46.67	13.33	15
	Combined	31.03	37.93	31.03	29
Ratio & Proportion	Employers	57.14	35.71	7.14	14
	Graduates	73.33	20.00	6.67	15
	Combined	65.52	27.59	6.90	29
Progressions	Employers	21.43	64.29	14.29	14
	Graduates	46.67	40.00	13.33	15
	Combined	34.48	51.72	13.79	29
Series; Expansions	Employers	14.29	42.86	42.86	14
	Graduates	46.67	33.33	20.00	15
	Combined	31.03	37.93	31.03	29

Table 17 Trigonometry (Items L.1. - L.6.)
Architectural Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Angles	Employers	78.57	21.43	0.00	14
	Graduates	93.33	0.00	6.67	15
	Combined	86.21	10.34	3.45	29
Trigonometric Functions	Employers	71.43	28.57	0.00	14
	Graduates	86.67	6.67	6.67	15
	Combined	79.31	17.24	3.45	29
Right Triangles	Employers	78.57	21.43	0.00	14
	Graduates	80.00	13.33	6.67	15
	Combined	79.31	17.24	3.45	29
Oblique Triangles	Employers	71.43	28.57	0.00	14
	Graduates	73.33	20.00	6.67	15
	Combined	72.41	24.14	3.45	29
Graphs of Trig Functions	Employers	50.00	50.00	0.00	14
	Graduates	53.33	40.00	6.67	15
	Combined	51.72	44.83	3.45	29
Inverse Trig Functions	Employers	28.57	64.29	7.14	14
	Graduates	53.33	40.00	6.67	15
	Combined	41.38	51.72	6.90	29

Table 18 Logarithms (Items M.1. - M.2.)
Architectural Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Exponential & Log Functions	Employers	15.38	38.46	46.15	13
	Graduates	37.50	56.25	6.25	16
	Combined	27.59	48.28	24.14	29
Logs of Trig Functions	Employers	21.43	35.71	42.86	14
	Graduates	37.50	50.00	12.50	16
	Combined	30.00	43.33	26.67	30

Table 19 Geometry - Figures and Formulas (Items N.1. - N.2.)
Architectural Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Plane Geometry	Employers	64.29	35.71	0.00	14
	Graduates	81.25	6.25	12.50	16
	Combined	73.33	20.00	6.67	30
Solid Geometry	Employers	57.14	42.86	0.00	14
	Graduates	75.00	12.50	12.50	16
	Combined	66.67	26.67	6.67	30

Table 20 Analytic Geometry (Items 0.1. - 0.4.)
Architectural Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Rectangular Coordinates	Employers	57.14	28.57	14.29	14
	Graduates	68.75	18.75	12.50	16
	Combined	63.33	23.33	13.33	30
Solving Equations Graphically	Employers	42.86	42.86	14.29	14
	Graduates	50.00	31.25	18.75	16
	Combined	46.67	36.67	16.67	30
Graphs of Log Functions	Employers	14.29	57.14	28.57	14
	Graduates	43.75	31.25	25.00	16
	Combined	30.00	43.33	26.67	30
Polar Coordinates	Employers	7.14	57.14	35.71	14
	Graduates	37.50	50.00	12.50	16
	Combined	23.33	53.33	23.33	30

Table 21 Calculus (Items P.1. - P.5.)
Architectural Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES Essential %	Desirable %	Not Needed %	Total N
Differentiation	Employers	7.14	64.29	28.57	14
	Graduates	50.00	43.75	6.25	16
	Combined	30.00	53.33	16.67	30
Integration	Employers	14.29	57.14	28.57	14
	Graduates	43.75	50.00	6.25	16
	Combined	30.00	53.33	16.67	30
Differentiation of Functions	Employers	7.69	23.08	69.23	13
	Graduates	37.50	37.50	25.00	16
	Combined	24.14	31.05	44.83	29
Differential Equations	Employers	7.69	23.08	69.23	13
	Graduates	25.00	56.25	18.75	16
	Combined	17.24	41.38	41.38	29
Laplace Transforms	Employers	8.33	16.67	75.00	12
	Graduates	18.75	43.75	37.50	16
	Combined	14.29	32.14	53.57	28

Table 22 Statistics (Items Q.1. - Q.5.)
Architectural Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Probability	Employers	0.00	7.14	92.86	14
	Graduates	37.50	43.75	18.75	16
	Combined	20.00	26.67	53.33	30
Frequency Distributions	Employers	0.00	0.00	100.00	13
	Graduates	25.00	62.50	12.50	16
	Combined	13.79	34.48	51.72	29
Variability	Employers	0.00	0.00	100.00	13
	Graduates	18.75	56.25	25.00	16
	Combined	10.34	31.03	58.62	29
Sampling Theory	Employers	0.00	0.00	100.00	13
	Graduates	25.00	43.75	31.25	16
	Combined	13.79	24.14	62.07	29
Hypothesis Testing	Employers	0.00	0.00	100.00	13
	Graduates	18.75	43.75	37.50	16
	Combined	10.34	24.14	65.52	29

Appendix C

Chemical Technology Tables

Table 23 Mechanics (Items A.1. - A.5.)
Chemical Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Statics	Employers	33.33	33.33	33.33	3
	Graduates	16.67	66.67	16.67	6
	Combined	22.22	55.56	22.22	9
Fluid Mechanics	Employers	33.33	33.33	33.33	3
	Graduates	33.33	50.00	16.67	6
	Combined	33.33	44.44	22.22	9
Properties of Materials	Employers	100.00	0.00	0.00	3
	Graduates	33.33	50.00	16.67	6
	Combined	55.56	33.33	11.11	9
Strength of Materials	Employers	33.33	33.33	33.33	3
	Graduates	0.00	16.67	83.33	6
	Combined	11.11	22.22	66.67	9
Dynamics	Employers	0.00	66.67	33.33	3
	Graduates	0.00	100.00	0.00	6
	Combined	0.00	88.89	11.11	9

Table 24 Fundamentals of Electricity/Electronics (Items B.1. - B.7.)
Chemical Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Electric Fields	Employers	0.00	33.33	66.67	3
	Graduates	0.00	33.33	66.67	6
	Combined	0.00	33.33	66.67	9
Magnetic Fields	Employers	0.00	66.67	33.33	3
	Graduates	0.00	33.33	66.67	6
	Combined	0.00	44.44	55.56	9
D.C. Electricity	Employers	0.00	100.00	0.00	3
	Graduates	16.67	50.00	33.33	6
	Combined	11.11	66.67	22.22	9
A.C. Electricity	Employers	0.00	100.00	0.00	3
	Graduates	0.00	50.00	50.00	6
	Combined	0.00	66.67	33.33	9
Electronics	Employers	0.00	33.33	66.67	3
	Graduates	0.00	50.00	50.00	6
	Combined	0.00	44.44	55.56	9
Electrical Devices	Employers	0.00	66.67	33.33	3
	Graduates	16.67	33.33	50.00	6
	Combined	11.11	44.44	44.44	9
Electro-magnetics	Employers	0.00	0.00	100.00	3
	Graduates	0.00	0.00	100.00	6
	Combined	0.00	0.00	100.00	9

Table 25 Light (Items C.1. - C.4.)
Chemical Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
General Theory	Employers	0.00	0.00	100.00	3
	Graduates	33.33	66.67	0.00	6
	Combined	22.22	44.44	33.33	9
Geometrical Optics	Employers	0.00	0.00	100.00	3
	Graduates	16.67	33.33	50.00	6
	Combined	11.11	22.22	66.67	9
Physical Optics	Employers	0.00	33.33	66.67	3
	Graduates	16.67	66.67	16.67	6
	Combined	11.11	55.56	33.33	9
Spectral Analysis	Employers	0.00	33.33	66.67	3
	Graduates	50.00	33.33	16.67	6
	Combined	33.33	33.33	33.33	9

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Table 26 Sound (Items D.1. - D.2.)
Chemical Technology

ITEM	GROUP	RESPONSE CATEGORIES Essential %	 Desirable %	 Not Needed %	Total N
General Theory	Employers	0.00	0.00	100.00	3
	Graduates	0.00	83.33	16.67	6
	Combined	0.00	55.57	44.44	9
Reception and Transmission	Employers	0.00	33.33	66.67	3
	Graduates	16.67	33.33	50.00	6
	Combined	11.11	33.33	55.56	9

Table 27 Heat (Items E.1.- E.3.)
Chemical Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
General Theory	Employers	66.67	33.33	0.00	3
	Graduates	50.00	50.00	0.00	6
	Combined	55.56	44.44	0.00	9
Heat Transfer	Employers	33.33	33.33	33.33	3
	Graduates	50.00	33.33	16.67	6
	Combined	44.44	33.33	22.22	9
Thermo-dynamics	Employers	33.33	33.33	33.33	3
	Graduates	66.67	33.33	0.00	6
	Combined	55.56	33.33	11.11	9

Table 28 Modern Physics (Items F.1. - F.3.)
Chemical Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Structure of Atom	Employers	33.33	33.33	33.33	3
	Graduates	83.33	16.67	0.00	6
	Combined	66.67	22.22	11.11	9
Relativity	Employers	0.00	33.33	66.67	3
	Graduates	50.00	33.33	16.67	6
	Combined	33.33	33.33	33.33	9
Fission, Fusion, Radio-activity	Employers	0.00	66.67	33.33	3
	Graduates	83.33	0.00	16.67	6
	Combined	55.56	22.22	22.22	9

Table 29 Chemistry (Items G.1. - G.5.)
Chemical Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
General Chemistry	Employers	66.67	33.33	0.00	3
	Graduates	100.00	0.00	0.00	6
	Combined	88.89	11.11	0.00	9
Qualitative Chemistry	Employers	66.67	0.00	33.33	3
	Graduates	100.00	0.00	0.00	6
	Combined	88.89	0.00	11.11	9
Quantitative Chemistry	Employers	66.67	0.00	33.33	3
	Graduates	100.00	0.00	0.00	6
	Combined	88.89	0.00	11.11	9
Physical Chemistry	Employers	0.00	66.67	33.33	3
	Graduates	83.33	16.67	0.00	6
	Combined	55.56	33.33	11.11	9
Organic Chemistry	Employers	33.33	33.33	33.33	3
	Graduates	66.67	33.33	0.00	6
	Combined	55.56	33.33	11.11	9

Table 30 Biology (Items H.1. - H.6.)
Chemical Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
General Biology	Employers	33.33	66.67	0.00	3
	Graduates	16.67	33.33	50.00	6
	Combined	22.22	44.44	33.33	9
Micro-biology	Employers	66.67	33.33	0.00	3
	Graduates	50.00	33.33	16.67	6
	Combined	55.56	33.33	11.11	9
Ecology	Employers	33.33	33.33	33.33	3
	Graduates	0.00	50.00	50.00	6
	Combined	11.11	44.44	44.44	9
Botany	Employers	0.00	66.67	33.33	3
	Graduates	16.67	16.67	66.67	6
	Combined	11.11	33.33	55.56	9
Zoology	Employers	0.00	33.33	66.67	3
	Graduates	16.67	16.67	66.67	6
	Combined	11.11	22.22	66.67	9
Genetics	Employers	0.00	0.00	100.00	3
	Graduates	0.00	16.67	83.33	6
	Combined	0.00	11.11	88.89	9

Table 31 Geology (Items I.1. - I.5.)
Chemical Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Physical Geology	Employers	0.00	66.67	33.33	3
	Graduates	16.67	16.67	66.67	6
	Combined	11.11	33.33	55.56	9
Economic Geology	Employers	33.33	33.33	33.33	3
	Graduates	33.33	33.33	33.33	6
	Combined	33.33	33.33	33.33	9
Structural Geology	Employers	0.00	33.33	66.67	3
	Graduates	16.67	33.33	50.00	6
	Combined	11.11	33.33	55.56	9
Geophysics	Employers	0.00	33.33	66.67	3
	Graduates	16.67	16.67	66.67	6
	Combined	11.11	22.22	66.67	9
Hydrology	Employers	66.67	0.00	33.33	3
	Graduates	33.33	0.00	66.67	6
	Combined	44.44	0.00	55.56	9

Table 32 Data Processing (Items J.1. - J.2.)
Chemical Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
FORTRAN	Employers	0.00	0.00	100.00	2
	Graduates	33.33	50.00	16.67	6
	Combined	25.00	37.50	37.50	8
BASIC	Employers	0.00	33.33	66.67	3
	Graduates	16.67	83.33	0.00	6
	Combined	11.11	66.67	22.22	9

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Table 33 Algebra (Items K.1. - K.14.)
Chemical Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Exponents and Radicals	Employers	100.00	0.00	0.00	3
	Graduates	66.67	33.33	0.00	6
	Combined	77.78	22.22	0.00	9
Scientific Notation	Employers	33.33	66.67	0.00	3
	Graduates	83.33	16.67	0.00	6
	Combined	66.67	33.33	0.00	9
Algebraic expressions	Employers	100.00	0.00	0.00	3
	Graduates	66.67	33.33	0.00	6
	Combined	77.78	22.22	0.00	9
Equations and Word Problems	Employers	100.00	0.00	0.00	3
	Graduates	100.00	0.00	0.00	6
	Combined	100.00	0.00	0.00	9
Determinants & Matrices	Employers	0.00	66.67	33.33	3
	Graduates	33.33	66.67	0.00	6
	Combined	22.22	66.67	11.11	9
Solutions to systems equations	Employers	33.33	66.67	0.00	3
	Graduates	66.67	33.33	0.00	6
	Combined	55.56	44.44	0.00	9
Factoring	Employers	33.33	66.67	0.00	3
	Graduates	66.67	33.33	0.00	6
	Combined	55.56	44.44	0.00	9
Fractions	Employers	100.00	0.00	0.00	3
	Graduates	100.00	0.00	0.00	6
	Combined	100.00	0.00	0.00	9
Quadratic Equations	Employers	66.67	0.00	33.33	3
	Graduates	66.67	33.33	0.00	6
	Combined	66.67	22.22	11.11	9

Table 33 Algebra (Items K.1. - K.14.)
(con't) Chemical Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Complex & Imaginary Numbers	Employers	0.00	33.33	66.67	3
	Graduates	33.33	50.00	16.67	6
	Combined	22.22	44.44	33.33	9
Inequalities	Employers	0.00	50.00	50.00	2
	Graduates	16.67	83.33	0.00	6
	Combined	12.50	75.00	12.50	8
Ratio & Proportion	Employers	100.00	0.00	0.00	3
	Graduates	83.33	16.67	0.00	6
	Combined	88.89	11.11	0.00	9
Progressions	Employers	33.33	0.00	66.67	3
	Graduates	50.00	50.00	0.00	6
	Combined	44.44	33.33	22.22	9
Series; Expansions	Employers	0.00	33.33	66.67	3
	Graduates	50.00	50.00	0.00	6
	Combined	33.33	44.44	22.22	9

Table 34 Trigonometry (Items L.1. - L.6.)
Chemical Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Angles	Employers	33.33	66.67	0.00	3
	Graduates	83.33	0.00	16.67	6
	Combined	66.67	22.22	11.11	9
Trigonometric Functions	Employers	33.33	66.67	0.00	3
	Graduates	83.33	0.00	16.67	6
	Combined	66.67	22.22	11.11	9
Right Triangles	Employers	66.67	33.33	0.00	2
	Graduates	83.33	0.00	16.67	6
	Combined	77.78	11.11	11.11	8
Oblique Triangles	Employers	33.33	66.67	0.00	3
	Graduates	83.33	0.00	16.67	6
	Combined	66.67	22.22	11.11	9
Graphs of Trig Functions	Employers	33.33	33.33	33.33	3
	Graduates	66.67	16.67	16.67	6
	Combined	55.56	22.22	22.22	9
Inverse Trig Functions	Employers	33.33	33.33	33.33	3
	Graduates	50.00	33.33	16.67	6
	Combined	44.44	33.33	22.22	9

Table 35 Logarithms (Items M.1. - M.2.)
Chemical Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Exponential & Log Functions	Employers	33.33	66.67	0.00	3
	Graduates	50.00	33.33	16.67	6
	Combined	44.44	44.44	11.11	9
Logs of Trig Functions	Employers	0.00	66.67	33.33	3
	Graduates	50.00	33.33	16.67	6
	Combined	33.33	44.44	22.22	9

Table 36 Geometry - Figures and Formulas (Items N.1. - N.2.)
Chemical Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Plane Geometry	Employers	66.67	0.00	33.33	3
	Graduates	16.67	66.67	16.67	6
	Combined	33.33	44.44	22.22	9
Solid Geometry	Employers	66.67	0.00	33.33	3
	Graduates	16.67	66.67	16.67	6
	Combined	33.33	44.44	22.22	9

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Table 37 Analytic Geometry (Items 0.1. - 0.4.)
Chemical Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Rectangular Coordinates	Employers	33.33	33.33	33.33	3
	Graduates	16.67	66.67	16.67	6
	Combined	22.22	55.56	22.22	9
Solving Equations Graphically	Employers	33.33	33.33	33.33	3
	Graduates	16.67	83.33	0.00	6
	Combined	22.22	66.67	11.11	9
Graphs of Log Functions	Employers	0.00	33.33	66.67	3
	Graduates	33.33	50.00	16.67	6
	Combined	22.22	44.44	33.33	9
Polar Coordinates	Employers	0.00	66.67	33.33	3
	Graduates	16.67	50.00	33.33	6
	Combined	11.11	55.56	33.33	9

Table 38 Calculus (Items P.1. - P.5.)
Chemical Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Differentiation	Employers	33.33	66.67	0.00	3
	Graduates	66.67	16.67	16.67	6
	Combined	55.56	33.33	11.11	9
Integration	Employers	33.33	66.67	0.00	3
	Graduates	66.67	33.33	0.00	6
	Combined	55.56	44.44	0.00	9
Differentiation of Functions	Employers	0.00	66.67	33.33	3
	Graduates	50.00	33.33	16.67	6
	Combined	33.33	44.44	22.22	9
Differential Equations	Employers	0.00	33.33	66.67	3
	Graduates	50.00	33.33	16.67	6
	Combined	33.33	33.33	33.33	9
Laplace Transforms	Employers	0.00	33.33	66.67	3
	Graduates	33.33	16.67	50.00	6
	Combined	22.22	22.22	55.56	9

Table 39 Statistics (Items Q.1. - Q.5.)
Chemical Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Probability	Employers	0.00	100.00	0.00	3
	Graduates	50.00	50.00	0.00	6
	Combined	33.33	66.67	0.00	9
Frequency Distributions	Employers	0.00	33.33	66.67	3
	Graduates	50.00	50.00	0.00	6
	Combined	33.33	44.44	22.22	9
Variability	Employers	0.00	33.33	66.67	3
	Graduates	66.67	33.33	0.00	6
	Combined	44.44	33.33	22.22	9
Sampling Theory	Employers	0.00	33.33	66.67	3
	Graduates	33.33	66.67	0.00	6
	Combined	22.22	55.56	22.22	9
Hypothesis Testing	Employers	0.00	33.33	66.67	3
	Graduates	33.33	33.33	33.33	6
	Combined	22.22	33.33	44.44	9

Appendix D

Civil Engineering Technology Tables

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Table 40 Mechanics (Items A.1. - A.5.)
Civil Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES Essential %	Desirable %	Not Needed %	Total N
Statics	Employers	58.33	37.50	4.17	24
	Graduates	60.78	37.25	1.96	51
	Combined	60.00	37.33	2.67	75
Fluid Mechanics	Employers	37.50	41.67	20.83	24
	Graduates	39.22	47.06	13.73	51
	Combined	38.67	45.33	16.00	75
Properties of Materials	Employers	52.17	39.13	8.70	23
	Graduates	49.02	45.10	5.88	51
	Combined	50.00	43.24	6.76	74
Strength of Materials	Employers	52.00	40.00	8.00	25
	Graduates	64.00	34.00	2.00	50
	Combined	60.00	36.00	4.00	75
Dynamics	Employers	32.00	40.00	28.00	25
	Graduates	28.00	52.00	20.00	50
	Combined	29.33	48.00	22.67	75

Table 41 Fundamentals of Electricity/Electronics (Items B.1. - B.7.)
Civil Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Electric Fields	Employers	4.17	16.67	79.17	24
	Graduates	6.12	46.94	46.94	49
	Combined	5.48	36.99	57.53	73
Magnetic Fields	Employers	4.17	16.67	79.17	24
	Graduates	8.16	44.90	46.94	49
	Combined	6.85	35.62	57.53	73
D. C. Electricity	Employers	8.33	37.50	54.17	24
	Graduates	10.20	51.02	38.78	49
	Combined	9.59	46.58	43.84	73
A. C. Electricity	Employers	8.00	40.00	52.00	25
	Graduates	10.20	51.02	38.78	49
	Combined	9.46	47.30	43.24	74
Electronics	Employers	4.17	25.00	70.83	24
	Graduates	6.12	40.82	53.06	49
	Combined	5.48	35.62	58.00	73
Electrical Devices	Employers	8.00	28.00	64.00	25
	Graduates	8.16	51.02	40.82	49
	Combined	8.11	43.24	48.65	74
Electro-magnetics	Employers	4.17	0.00	95.83	24
	Graduates	2.04	36.73	61.22	49
	Combined	2.74	24.60	72.60	73

Table 42 Light (Items C.1. - C.4.)
Civil Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
General Theory	Employers	0.00	36.00	64.00	25
	Graduates	10.00	56.00	34.00	50
	Combined	6.67	49.33	44.00	75
Geometrical Optics	Employers	4.00	24.00	72.00	25
	Graduates	8.00	44.00	48.00	50
	Combined	6.67	37.33	56.00	75
Physical Optics	Employers	4.00	20.00	76.00	25
	Graduates	4.00	42.00	54.00	56
	Combined	4.00	34.67	61.33	75
Spectral Analysis	Employers	0.00	24.00	76.00	25
	Graduates	0.00	38.00	62.00	50
	Combined	0.00	33.33	66.67	75

Table 43 Sound (Items D.1. - D.2.)
Civil Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
General Theory	Employers	0.00	36.00	64.00	25
	Graduates	6.00	50.00	44.00	50
	Combined	4.00	45.33	50.67	75
Reception and Transmission	Employers	0.00	24.00	76.00	25
	Graduates	0.00	46.00	54.00	50
	Combined	0.00	38.67	61.33	75

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Table 44 Heat (Items E.1. - E.3.)
Civil Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES Essential %	 Desirable %	 Not Needed %	Total N
General Theory	Employers	8.33	50.00	41.67	24
	Graduates	28.00	42.00	30.00	50
	Combined	21.62	44.59	33.78	74
Heat Transfer	Employers	4.00	48.00	48.00	25
	Graduates	18.00	50.00	32.00	50
	Combined	13.33	49.33	37.33	75
Thermo-dynamics	Employers	4.17	41.67	54.17	24
	Graduates	24.00	32.00	44.00	50
	Combined	17.57	35.14	47.30	74

Table 45 Modern Physics (Items F.1. - F.3.)
Civil Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES Essential %	 Desirable %	 Not Needed %	Total N
Structure of Atom	Employers	0.00	32.00	68.00	25
	Graduates	7.84	41.18	50.98	51
	Combined	5.26	38.16	56.58	76
Relativity	Employers	0.00	24.00	76.00	25
	Graduates	5.88	29.41	64.71	51
	Combined	3.95	27.63	68.42	76
Fission, Fusion, Radio-activity	Employers	0.00	16.00	84.00	25
	Graduates	7.84	35.29	56.86	51
	Combined	5.26	28.95	65.79	76

Table 46 Chemistry (Items G.1. - G.5.)
Civil Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
General Chemistry	Employers	16.00	40.00	44.00	25
	Graduates	14.00	46.00	40.00	50
	Combined	14.67	44.00	41.33	75
Qualitative Chemistry	Employers	4.00	20.00	76.00	25
	Graduates	10.00	26.00	64.00	50
	Combined	8.00	24.00	68.00	75
Quantitative Chemistry	Employers	4.00	20.00	76.00	25
	Graduates	10.00	24.00	66.00	50
	Combined	8.00	22.67	69.33	75
Physical Chemistry	Employers	0.00	20.00	80.00	25
	Graduates	6.00	30.00	64.00	50
	Combined	4.00	26.67	69.33	75
Organic Chemistry	Employers	4.00	16.00	80.00	25
	Graduates	10.00	26.00	64.00	50
	Combined	8.00	22.67	69.33	75

Table 47 Biology (Items H.1. - H.6.)
Civil Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
General Biology	Employers	4.00	28.00	68.00	25
	Graduates	8.16	32.65	59.18	49
	Combined	6.76	31.08	62.16	74
Micro-biology	Employers	8.00	24.00	68.00	25
	Graduates	12.24	30.61	57.14	49
	Combined	10.81	28.38	60.81	74
Ecology	Employers	4.00	40.00	56.00	25
	Graduates	12.24	38.78	48.98	49
	Combined	9.46	39.19	51.35	74
Botany	Employers	4.00	16.00	80.00	25
	Graduates	0.00	28.57	71.43	49
	Combined	1.35	24.32	74.32	74
Zoology	Employers	4.00	4.00	92.00	25
	Graduates	0.00	16.33	83.67	49
	Combined	1.35	12.16	86.49	74
Genetics	Employers	0.00	4.00	96.00	25
	Graduates	0.00	10.20	89.80	49
	Combined	0.00	8.11	91.89	74

Table 48 Geology (Items I.1. - I.5.)
Civil Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Physical Geology	Employers	36.00	52.00	12.00	25
	Graduates	35.29	54.90	9.80	51
	Combined	35.53	53.95	10.53	76
Economic Geology	Employers	12.50	33.33	54.17	24
	Graduates	15.69	49.02	35.29	51
	Combined	14.67	44.00	41.33	75
Structural Geology	Employers	20.83	41.67	37.50	24
	Graduates	29.41	43.14	27.45	51
	Combined	26.67	42.67	30.67	75
Geophysics	Employers	8.70	21.74	69.57	23
	Graduates	13.73	47.06	39.22	51
	Combined	12.16	39.19	48.65	74
Hydrology	Employers	60.00	32.00	8.00	25
	Graduates	61.54	34.62	3.85	52
	Combined	61.04	33.77	5.19	77

Table 49 Data Processing (Items J.1. - J.2.)
Civil Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
FORTRAN	Employers	20.00	45.00	35.00	20
	Graduates	36.17	27.66	36.17	47
	Combined	31.34	32.84	35.82	67
BASIC	Employers	22.73	45.45	31.82	22
	Graduates	36.96	34.78	28.26	46
	Combined	32.35	38.24	29.41	68

Table 50 Algebra (Items K.1. - K.14.)
Civil Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Exponents and Radicals	Employers	68.00	20.00	12.00	25
	Graduates	75.00	23.00	1.92	52
	Combined	72.73	22.08	5.19	77
Scientific Notation	Employers	52.00	36.00	12.00	25
	Graduates	75.00	21.15	3.85	52
	Combined	67.53	25.97	6.49	77
Algebraic expressions	Employers	100.00	0.00	0.00	25
	Graduates	90.38	9.62	0.00	52
	Combined	93.51	6.49	0.00	77
Equations and Word Problems	Employers	72.00	24.00	4.00	25
	Graduates	86.54	11.54	1.92	52
	Combined	81.82	15.58	2.60	77
Determinants & Matrices	Employers	44.00	28.00	28.00	25
	Graduates	57.69	28.85	13.46	52
	Combined	53.25	28.57	18.18	77
Solutions to systems equations	Employers	68.00	28.00	4.00	25
	Graduates	71.15	25.00	3.85	52
	Combined	70.13	25.97	3.90	77
Factoring	Employers	64.00	24.00	12.00	25
	Graduates	63.46	26.92	9.62	52
	Combined	63.64	25.97	10.39	77
Fractions	Employers	96.00	4.00	0.00	25
	Graduates	88.46	11.54	0.00	52
	Combined	90.91	9.09	0.00	77
Quadratic Equations	Employers	72.00	20.00	8.00	25
	Graduates	69.23	21.15	9.62	52
	Combined	70.13	20.78	9.09	77

Table 50 Algebra (Items K.1. - K.14.)
(con't) Civil Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Complex & Imaginary Numbers	Employers	40.00	24.00	36.00	25
	Graduates	46.15	34.62	19.23	52
	Combined	44.16	31.17	24.68	77
Inequalities	Employers	40.00	20.00	40.00	25
	Graduates	53.85	30.77	15.38	52
	Combined	49.35	27.27	23.38	77
Ratio & Proportion	Employers	84.00	12.00	4.00	25
	Graduates	84.62	15.38	0.00	52
	Combined	84.42	14.29	1.30	77
Progressions	Employers	54.17	41.67	4.17	24
	Graduates	59.62	28.85	11.54	52
	Combined	57.89	32.89	9.21	76
Series; Expanions	Employers	45.83	29.17	25.00	24
	Graduates	44.23	42.31	13.46	52
	Combined	44.74	38.16	17.11	76

Table 51 Trigonometry (Items L.1. - L.6.)
Civil Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essentital %	Desirable %	Not Needed %	
Angles	Employers	100.00	0.00	0.00	25
	Graduates	100.00	0.00	0.00	52
	Combined	100.00	0.00	0.00	77
Trigonometric Functions	Employers	96.00	4.00	0.00	25
	Graduates	94.23	5.77	0.00	52
	Combined	94.81	5.19	0.00	77
Right Triangles	Employers	96.00	4.00	0.00	25
	Graduates	96.15	3.85	0.00	52
	Combined	96.10	3.90	0.00	77
Oblique Triangles	Employers	96.00	4.00	0.00	25
	Graduates	96.15	3.85	0.00	52
	Combined	96.10	3.90	0.00	77
Graphs of Trig Functions	Employers	64.00	28.00	8.00	25
	Graduates	67.31	25.00	7.69	52
	Combined	66.23	25.97	7.79	77
Inverse Trig Functions	Employers	64.00	24.00	12.00	25
	Graduates	69.23	23.08	7.69	52
	Combined	67.53	23.38	9.09	77

Table 52 Logarithms (Items M.1. - M.2.)
Civil Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Exponential & Log Functions	Employers	28.00	64.00	8.00	25
	Graduates	42.31	34.62	23.08	52
	Combined	37.66	44.16	18.18	77
Logs of Trig Functions	Employers	28.00	60.00	12.00	25
	Graduates	38.46	40.38	21.15	52
	Combined	35.06	46.75	18.18	77

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Table 53 Geometry - Figures and Formulas (Items N.1. - N.2.)
Civil Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Plane Geometry	Employers	84.00	16.00	0.00	25
	Graduates	84.62	13.46	1.92	52
	Combined	84.42	14.29	1.30	77
Solid Geometry	Employers	60.00	24.00	16.00	25
	Graduates	80.77	19.23	0.00	52
	Combined	74.03	20.78	5.19	77

Table 54 Analytic Geometry (Items 0.1. - 0.4.)
Civil Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Rectangular Coordinates	Employers	64.00	20.00	16.00	25
	Graduates	80.77	15.38	3.85	52
	Combined	75.32	16.88	7.79	77
Solving Equations Graphically	Employers	56.00	28.00	16.00	25
	Graduates	63.46	32.69	3.85	52
	Combined	61.04	31.17	7.79	77
Graphs of Log Functions	Employers	24.00	36.00	40.00	25
	Graduates	38.46	40.38	21.15	52
	Combined	33.77	38.96	27.27	77
Polar Coordinates	Employers	44.00	28.00	28.00	25
	Graduates	67.31	28.85	3.85	52
	Combined	59.74	28.57	11.69	77

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Table 55 Calculus (Items P.1. - P.5.)
Civil Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Differentiation	Employers	52.00	24.00	24.00	25
	Graduates	71.15	21.15	7.69	52
	Combined	64.94	22.08	12.99	77
Integration	Employers	40.00	32.00	28.00	25
	Graduates	69.23	23.08	7.69	52
	Combined	59.74	25.97	14.29	77
Differentiation of Functions	Employers	29.17	20.83	50.00	24
	Graduates	42.31	38.46	19.23	52
	Combined	38.16	32.89	28.95	76
Differential Equations	Employers	25.00	25.00	50.00	24
	Graduates	44.23	38.46	17.31	52
	Combined	38.16	34.21	27.63	76
Laplace Transforms	Employers	12.50	25.00	62.50	24
	Graduates	20.00	44.00	36.00	50
	Combined	17.57	37.84	44.59	74

Table 56 Statistics (Items Q.1. - Q.5.)
Civil Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Probability	Employers	24.00	48.00	28.00	25
	Graduates	25.00	51.92	23.08	52
	Combined	24.68	50.65	24.68	77
Frequency Distributions	Employers	16.00	28.00	56.00	25
	Graduates	17.31	46.15	36.54	52
	Combined	16.88	40.26	42.86	77
Variability	Employers	20.00	32.00	48.00	25
	Graduates	21.15	48.08	30.77	52
	Combined	20.78	42.86	36.36	77
Sampling Theory	Employers	20.00	20.00	60.00	25
	Graduates	15.69	43.14	41.18	51
	Combined	17.11	35.53	47.37	76
Hypothesis Testing	Employers	8.00	28.00	64.00	25
	Graduates	9.80	49.02	41.18	51
	Combined	9.21	42.11	48.68	76

Appendix E

Computer Technology Tables

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Table 57 Mechanics (Items A.1. - A.5.)
Computer Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Statics	Employers	0.00	20.00	80.00	10
	Graduates	10.00	60.00	30.00	10
	Combined	5.00	40.00	55.00	20
Fluid Mechanics	Employers	10.00	10.00	80.00	10
	Graduates	0.00	40.00	60.00	10
	Combined	5.00	25.00	70.00	20
Properties of Materials	Employers	0.00	20.00	80.00	10
	Graduates	10.00	50.00	40.00	10
	Combined	5.00	35.00	60.00	20
Strength of Materials	Employers	0.00	20.00	80.00	10
	Graduates	20.00	10.00	70.00	10
	Combined	10.00	15.00	75.00	20
Dynamics	Employers	0.00	30.00	70.00	10
	Graduates	20.00	50.00	30.00	10
	Combined	10.00	40.00	50.00	20

Table 58 Fundamentals of Electricity/Electronics (Items B.1. - B.7.)
Computer Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Electric Fields	Employers	60.00	20.00	20.00	10
	Graduates	70.00	30.00	0.00	10
	Combined	65.00	25.00	10.00	20
Magnetic Fields	Employers	50.00	20.00	30.00	10
	Graduates	70.00	20.00	10.00	10
	Combined	60.00	20.00	20.00	20
D.C. Electricity	Employers	80.00	0.00	20.00	10
	Graduates	90.00	0.00	10.00	10
	Combined	85.00	0.00	15.00	20
A.C. Electricity	Employers	80.00	0.00	20.00	10
	Graduates	100.00	0.00	0.00	10
	Combined	90.00	0.00	10.00	20
Electronics	Employers	70.00	20.00	10.00	10
	Graduates	90.00	0.00	10.00	10
	Combined	80.00	10.00	10.00	20
Electrical Devices	Employers	60.00	20.00	20.00	10
	Graduates	90.00	10.00	0.00	10
	Combined	75.00	15.00	10.00	20
Electro-Magnetics	Employers	40.00	20.00	40.00	10
	Graduates	40.00	50.00	10.00	10
	Combined	40.00	35.00	25.00	20

Table 59 Light (Items C.1. - C.4.)
Computer Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
General Theory	Employers	0.00	40.00	60.00	10
	Graduates	20.00	70.00	10.00	10
	Combined	10.00	55.00	35.00	20
Geometrical Optics	Employers	0.00	40.00	60.00	10
	Graduates	10.00	60.00	30.00	10
	Combined	5.00	50.00	45.00	20
Physical Optics	Employers	10.00	40.00	50.00	10
	Graduates	10.00	70.00	20.00	10
	Combined	10.00	55.00	35.00	20
Spectral Analysis	Employers	0.00	11.11	88.89	9
	Graduates	0.00	33.33	66.67	9
	Combined	0.00	22.22	77.78	18

Table 60 Sound (Items D.1. - D.2)
Computer Technology

ITEM	GROUP	RESPONSE CATEGORIES Essential %	Desirable %	Not Needed %	Total N
General Theory	Employers	0.00	40.00	60.00	10
	Graduates	30.00	40.00	30.00	10
	Combined	15.00	40.00	45.00	20
Reception and Transmission	Employers	0.00	40.00	60.00	10
	Graduates	40.00	40.00	20.00	10
	Combined	20.00	40.00	40.00	20

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Table 61 Heat (Items E.1. - E.3)
Computer Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
General Theory	Employers	0.00	30.00	70.00	10
	Graduates	30.00	50.00	20.00	10
	Combined	15.00	40.00	45.00	20
Heat Transfer	Employers	0.00	50.00	50.00	10
	Graduates	10.00	90.00	0.00	10
	Combined	5.00	70.00	25.00	20
Thermo-dynamics	Employers	0.00	10.00	90.00	10
	Graduates	0.00	60.00	40.00	10
	Combined	0.00	35.00	65.00	20

Table 62 Modern Physics (Items F.1. - F.2.)
Computer Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Structure of Atom	Employers	0.00	10.00	90.00	10
	Graduates	30.00	30.00	40.00	10
	Combined	15.00	20.00	65.00	20
Relativity	Employers	0.00	0.00	100.00	10
	Graduates	20.00	40.00	40.00	10
	Combined	10.00	20.00	70.00	20
Fission, Fusion, Radio-activity	Employers	0.00	10.00	90.00	10
	Graduates	30.00	40.00	30.00	10
	Combined	15.00	25.00	60.00	20

Table 63 Chemistry (Items G.1. - G.5.)
Computer Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
General Chemistry	Employers	0.00	10.00	90.00	10
	Graduates	0.00	55.56	44.44	9
	Combined	0.00	31.58	68.42	19
Qualitative Chemistry	Employers	0.00	0.00	100.00	10
	Graduates	0.00	30.00	70.00	10
	Combined	0.00	15.00	85.00	20
Quantitative Chemistry	Employers	0.00	0.00	100.00	10
	Graduates	0.00	30.00	70.00	10
	Combined	0.00	15.00	85.00	20
Physical Chemistry	Employers	0.00	10.00	90.00	10
	Graduates	0.00	60.00	40.00	10
	Combined	0.00	35.00	65.00	20
Organic Chemistry	Employers	0.00	0.00	100.00	10
	Graduates	0.00	30.00	70.00	10
	Combined	0.00	15.00	85.00	20

Table 64 Biology (Items H.1. - H.6.)
Computer Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
General Biology	Employers	0.00	11.11	88.89	9
	Graduates	0.00	0.00	100.00	10
	Combined	0.00	5.26	94.74	19
Micro-biology	Employers	0.00	0.00	100.00	9
	Graduates	0.00	10.00	90.00	10
	Combined	0.00	5.26	94.74	19
Ecology	Employers	0.00	11.11	88.89	9
	Graduates	10.00	0.00	90.00	10
	Combined	5.26	5.26	89.47	19
Botany	Employers	0.00	0.00	100.00	9
	Graduates	0.00	0.00	100.00	10
	Combined	0.00	0.00	100.00	19
Zoology	Employers	0.00	0.00	100.00	9
	Graduates	0.00	0.00	100.00	10
	Combined	0.00	0.00	100.00	19
Genetics	Employers	0.00	0.00	100.00	9
	Graduates	0.00	0.00	100.00	10
	Combined	0.00	0.00	100.00	19

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Table 65 Geology (Items I.1. - I.5)
Computer Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Physical Geology	Employers	0.00	11.11	88.89	9
	Graduates	0.00	30.00	70.00	10
	Combined	0.00	21.05	78.95	19
Economic Geology	Employers	0.00	0.00	100.00	9
	Graduates	0.00	30.00	70.00	10
	Combined	0.00	15.79	84.21	19
Structural Geology	Employers	0.00	0.00	100.00	9
	Graduates	0.00	0.00	100.00	10
	Combined	0.00	0.00	100.00	19
Geophysics	Employers	0.00	0.00	100.00	9
	Graduates	0.00	0.00	100.00	10
	Combined	0.00	0.00	100.00	19
Hydrology	Employers	0.00	0.00	100.00	9
	Graduates	0.00	10.00	90.00	10
	Combined	0.00	5.26	94.74	19

Table 66 Data Processing (Items J.1. - J.2.)
Computer Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
FORTRAN	Employers	11.11	66.67	22.22	9
	Graduates	33.33	55.56	11.11	9
	Combined	22.22	61.11	16.67	18
BASIC	Employers	33.33	55.56	11.11	9
	Graduates	40.00	50.00	10.00	10
	Combined	36.84	52.63	10.53	19

Table 67 Algebra (Items K.1. - K.14.)
Computer Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Exponents and Radicals	Employers	30.00	40.00	15.00	10
	Graduates	80.00	10.00	10.00	10
	Combined	55.00	25.00	20.00	20
Scientific Notation	Employers	30.00	20.00	50.00	10
	Graduates	80.00	10.00	10.00	10
	Combined	55.00	15.00	30.00	20
Algebraic expressions	Employers	40.00	50.00	10.00	10
	Graduates	90.00	10.00	0.00	10
	Combined	65.00	30.00	5.00	20
Equations and Word Problems	Employers	40.00	50.00	10.00	10
	Graduates	80.00	20.00	0.00	10
	Combined	60.00	35.00	5.00	20
Determinants & Matrices	Employers	33.33	22.22	44.44	9
	Graduates	40.00	50.00	10.00	10
	Combined	36.84	36.84	26.32	19
Solutions to systems equations	Employers	33.33	33.33	33.33	9
	Graduates	60.00	30.00	10.00	10
	Combined	47.37	31.58	21.05	19
Factoring	Employers	33.33	44.44	22.22	9
	Graduates	60.00	30.00	10.00	10
	Combined	47.37	36.84	15.79	19
Fractions	Employers	44.44	33.33	22.22	9
	Graduates	60.00	40.00	0.00	10
	Combined	52.63	36.84	10.53	19
Quadratic Equations	Employers	22.22	44.44	33.33	9
	Graduates	60.00	40.00	0.00	10
	Combined	42.11	42.11	15.79	19

Table 67 Algebra (Items K.1. - K.14)
Computer Technology

ITEM	GROUP	RESPONSE CATEGORIES Essential %	Desirable %	Not Needed %	Total N
Complex & Imaginary Numbers	Employers	22.22	44.44	33.33	9
	Graduates	40.00	40.00	20.00	10
	Combined	31.58	42.11	26.32	19
Inequalities	Employers	44.44	22.22	33.33	9
	Graduates	40.00	50.00	10.00	10
	Combined	42.11	36.84	21.05	19
Ratio & Proportion	Employers	30.00	40.00	30.00	10
	Graduates	70.00	30.00	0.00	10
	Combined	50.00	35.00	15.00	20
Progressions	Employers	22.22	33.33	44.44	9
	Graduates	40.00	50.00	10.00	10
	Combined	31.58	42.11	26.32	19
Series; Expansions	Employers	22.22	22.22	55.56	9
	Graduates	40.00	40.00	20.00	10
	Combined	31.58	31.58	36.84	19

Table 68 Trigonometry (Items L.1. - L.6.)
Computer Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Angles	Employers	22.22	33.33	44.44	9
	Graduates	70.00	10.00	20.00	10
	Combined	47.37	21.05	31.58	19
Trigonometric Functions	Employers	12.50	37.50	50.00	8
	Graduates	70.00	10.00	20.00	10
	Combined	44.44	22.22	33.33	18
Right Triangles	Employers	12.50	25.00	62.50	8
	Graduates	60.00	20.00	20.00	10
	Combined	38.89	22.22	38.89	18
Oblique Triangles	Employers	12.50	25.00	62.50	8
	Graduates	60.00	10.00	30.00	10
	Combined	38.89	16.67	44.44	18
Graphs of Trig Functions	Employers	12.50	25.00	62.50	8
	Graduates	60.00	10.00	30.00	10
	Combined	38.89	16.67	44.44	18
Inverse Trig Functions	Employers	12.50	25.00	62.50	8
	Graduates	50.00	20.00	30.00	10
	Combined	33.33	22.22	44.44	18

Table 69 Logarithms (Items M.1. - M.2.)
Computer Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Exponential & Log Functions	Employers	12.50	75.00	12.50	8
	Graduates	60.00	20.00	20.00	10
	Combined	38.89	44.44	16.67	18
Logs of Trig Functions	Employers	12.50	62.50	25.00	8
	Graduates	50.00	20.00	30.00	10
	Combined	33.33	38.89	27.78	18

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Table 70 Geometry - Figures and Formulas (Items N.1. - N.2.)
Computer Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Plane Geometry	Employers	12.50	25.00	62.50	8
	Graduates	30.00	70.00	0.00	10
	Combined	22.22	50.00	27.78	18
Solid Geometry	Employers	12.50	25.00	62.50	8
	Graduates	30.00	60.00	10.00	10
	Combined	22.22	44.44	33.33	18

Table 71 Analytic Geometry (Items O.1. - O.4.)
Computer Technology

ITEM	GROUP	RESPONSE CATEGORIES Essential %	Desirable %	Not Needed %	Total N
Rectangular Coordinates	Employers	11.11	22.22	66.67	9
	Graduates	30.00	50.00	20.00	10
	Combined	21.05	36.84	42.11	19
Solving Equations Graphically	Employers	11.11	33.33	55.56	9
	Graduates	50.00	40.00	10.00	10
	Combined	31.58	36.84	31.58	19
Graphs of Log Functions	Employers	22.22	22.22	55.56	9
	Graduates	30.00	50.00	20.00	10
	Combined	26.32	36.84	36.84	19
Polar Coordinates	Employers	11.11	22.22	66.67	9
	Graduates	30.00	50.00	20.00	10
	Combined	21.05	36.84	42.11	19

Table 72 Calculus (Items P.1. - P.5.)
Computer Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Differentiation	Employers	12.50	0.00	87.50	8
	Graduates	70.00	10.00	20.00	10
	Combined	44.44	5.56	50.00	18
Integration	Employers	12.50	0.00	87.50	8
	Graduates	60.00	20.00	20.00	10
	Combined	38.89	11.11	50.00	18
Differentiation of Functions	Employers	0.00	12.50	87.50	8
	Graduates	60.00	20.00	20.00	10
	Combined	33.33	16.67	50.00	18
Differential Equations	Employers	0.00	25.00	75.00	8
	Graduates	50.00	40.00	10.00	10
	Combined	27.78	33.33	38.89	18
Laplace Transforms	Employers	0.00	0.00	100.00	8
	Graduates	20.00	60.00	20.00	10
	Combined	11.11	33.33	55.56	18

Table 73 Statistics (Items Q.1. - Q.5.)
Computer Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Probability	Employers	11.11	22.22	66.67	9
	Graduates	10.00	40.00	50.00	10
	Combined	10.53	31.58	57.89	19
Frequency Distributions	Employers	11.11	33.33	55.56	9
	Graduates	10.00	40.00	50.00	10
	Combined	10.53	36.84	52.63	19
Variability	Employers	11.11	33.33	55.56	9
	Graduates	10.00	30.00	60.00	10
	Combined	10.53	31.58	57.89	19
Sampling Theory	Employers	11.11	33.33	55.56	9
	Graduates	20.00	20.00	60.00	10
	Combined	15.79	26.32	57.89	19
Hypothesis Testing	Employers	0.00	55.56	44.44	9
	Graduates	20.00	30.00	50.00	10
	Combined	10.53	42.11	47.37	19

Appendix F

Electronic Engineering Technology Tables

Table 74 Mechanics (Items A.1. - A.5.)
Electronics Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Statics	Employers	10.00	40.00	50.00	10
	Graduates	5.26	63.16	31.58	19
	Combined	6.90	55.17	37.91	29
Fluid Mechanics	Employers	0.00	10.00	90.00	10
	Graduates	5.26	47.37	47.37	19
	Combined	3.45	34.48	62.07	29
Properties of Materials	Employers	0.00	50.00	50.00	10
	Graduates	10.53	57.89	31.58	19
	Combined	6.90	55.17	37.93	29
Strength of Materials	Employers	0.00	30.00	70.00	10
	Graduates	11.11	22.22	66.67	18
	Combined	7.14	25.00	67.86	28
Dynamics	Employers	10.00	50.00	40.00	10
	Graduates	16.67	66.67	16.67	18
	Combined	14.29	60.71	25.00	28

Table 75 Fundamentals of Electricity/Electronics (Items B.1. - B.7.)
Electronics Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Electric Fields	Employers	90.91	9.09	0.00	11
	Graduates	80.00	20.00	0.00	20
	Combined	83.87	16.13	0.00	31
Magnetic Fields	Employers	90.91	9.09	0.00	11
	Graduates	80.00	20.00	0.00	20
	Combined	83.87	16.13	0.00	31
D.C. Electricity	Employers	100.00	0.00	0.00	11
	Graduates	90.00	10.00	0.00	20
	Combined	93.55	6.45	0.00	31
A.C. Electricity	Employers	100.00	0.00	0.00	11
	Graduates	90.00	10.00	0.00	20
	Combined	93.55	6.45	0.00	31
Electronics	Employers	90.91	9.09	0.00	11
	Graduates	95.00	0.00	5.00	20
	Combined	93.55	3.23	3.23	31
Electrical Devices	Employers	72.73	18.18	9.09	11
	Graduates	90.00	10.00	0.00	20
	Combined	83.87	12.90	3.23	31
Electromagnetics	Employers	54.55	27.27	18.18	11
	Graduates	75.00	25.00	0.00	20
	Combined	67.74	25.81	6.45	31

Table 76 Light (Items C.1. - C.4.)
Electronics Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
General Theory	Employers	27.27	45.45	27.27	11
	Graduates	42.11	57.89	0.00	19
	Combined	36.67	53.33	10.00	30
Geometrical Optics	Employers	9.09	54.55	36.36	11
	Graduates	10.53	78.95	10.53	19
	Combined	10.00	70.00	20.00	30
Physical Optics	Employers	18.18	27.27	54.55	11
	Graduates	15.79	68.42	15.79	19
	Combined	16.67	53.33	30.00	30
Spectral Analysis	Employers	0.00	27.27	72.73	11
	Graduates	10.53	57.89	31.58	19
	Combined	6.67	46.67	46.67	30

Table 77 Sound (Items D.1. - D.2.)
Electronics Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES Essential %	Desirable %	Not Needed %	Total N
General Theory	Employers	30.00	70.00	0.00	10
	Graduates	52.63	26.32	21.05	19
	Combined	44.83	41.38	13.79	29
Reception and Transmission	Employers	10.00	60.00	30.00	10
	Graduates	52.63	15.79	31.58	19
	Combined	37.93	31.03	31.03	29

Table 78 Heat (Items E.1. - E.3.)
Electronics Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES Essential %	 Desirable %	 Not Needed %	Total N
General Theory	Employers	10.00	70.00	20.00	10
	Graduates	26.32	47.37	26.32	19
	Combined	20.69	55.17	24.14	29
Heat Transfer	Employers	10.00	80.00	10.00	10
	Graduates	21.05	52.63	26.32	19
	Combined	17.24	62.07	20.69	29
Thermo-dynamics	Employers	0.00	60.00	40.00	10
	Graduates	10.53	36.84	52.63	19
	Combined	6.90	44.83	48.28	20

Table 79 Modern Physics (Items F.1. - F.3.)
Electronics Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES Essential %	 Desirable %	 Not Needed %	Total N
Structure of Atom	Employers	20.00	60.00	20.00	10
	Graduates	42.11	52.63	5.26	19
	Combined	34.48	55.17	10.34	29
Relativity	Employers	10.00	40.00	50.00	10
	Graduates	31.58	42.11	26.32	19
	Combined	24.14	41.38	34.48	29
Fission, Fusion, Radioactivity	Employers	10.00	30.00	60.00	10
	Graduates	26.32	52.63	21.05	19
	Combined	20.69	44.83	34.48	29

Table 80 Chemistry (Items G.1. - G.5.)
Electronics Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES Essential %	Desirable %	Not Needed %	Total N
General Chemistry	Employers	10.00	50.00	40.00	10
	Graduates	26.32	36.84	36.84	19
	Combined	20.69	41.38	37.93	29
Qualitative Chemistry	Employers	0.00	10.00	90.00	10
	Graduates	0.00	21.05	78.95	19
	Combined	0.00	17.24	82.76	29
Quantitative Chemistry	Employers	0.00	0.00	100.00	10
	Graduates	0.00	26.32	73.68	19
	Combined	0.00	17.24	82.76	29
Physical Chemistry	Employers	0.00	50.00	50.00	10
	Graduates	10.53	31.58	57.89	19
	Combined	6.90	37.93	55.17	29
Organic Chemistry	Employers	0.00	10.00	90.00	10
	Graduates	5.26	10.53	84.21	19
	Combined	3.45	10.34	86.21	29

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Table 81 Biology (Items H.1. - H.6.)
Electronics Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
General Biology	Employers	0.00	30.00	70.00	10
	Graduates	0.00	10.53	89.47	19
	Combined	0.00	17.24	82.76	20
Micro-biology	Employers	0.00	10.00	90.00	10
	Graduates	0.00	10.53	89.47	19
	Combined	0.00	10.34	89.66	29
Ecology	Employers	0.00	20.00	80.00	10
	Graduates	5.26	21.05	73.68	19
	Combined	3.45	20.69	75.86	29
Botany	Employers	0.00	0.00	100.00	10
	Graduates	0.00	0.00	100.00	19
	Combined	0.00	0.00	100.00	29
Zoology	Employers	0.00	0.00	100.00	10
	Graduates	0.00	0.00	100.00	19
	Combined	0.00	0.00	100.00	29
Genetics	Employers	0.00	0.00	100.00	10
	Graduates	0.00	5.26	94.74	19
	Combined	0.00	3.45	96.55	29

Table 82 Geology (Items I.1. - I.5.)
Electronics Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES Essential %	 Desirable %	 Not Needed %	Total N
Physical Geology	Employers	0.00	30.00	70.00	10
	Graduates	0.00	15.79	84.21	19
	Combined	0.00	20.69	79.31	29
Economic Geology	Employers	10.00	20.00	70.00	10
	Graduates	0.00	10.53	89.47	19
	Combined	3.45	13.79	82.76	29
Structural Geology	Employers	0.00	20.00	80.00	10
	Graduates	0.00	5.26	94.74	19
	Combined	0.00	10.34	89.66	29
Geophysics	Employers	0.00	10.00	90.00	10
	Graduates	0.00	5.26	94.74	19
	Combined	0.00	6.90	93.10	29
Hydrology	Employers	0.00	10.00	90.00	10
	Graduates	0.00	5.26	94.74	19
	Combined	0.00	6.90	93.10	29

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Table 83 Data Processing (Items J.1. - J.2.)
Electronics Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES Essential %	Desirable %	Not Needed %	Total N
FORTRAN	Employers	20.00	50.00	30.00	10
	Graduates	36.84	52.63	10.53	19
	Combined	31.03	51.72	17.24	29
BASIC	Employers	50.00	20.00	30.00	10
	Graduates	37.50	43.75	18.75	16
	Combined	42.31	34.62	23.08	26

Table 84 Algebra (Items K.1. - K.14)
Electronics Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES Essential %	Desirable %	Not Needed %	Total N
Exponents and Radicals	Employers	88.89	11.11	0.00	9
	Graduates	75.00	20.00	5.00	20
	Combined	79.31	17.24	3.45	29
Scientific Notation	Employers	88.89	11.11	0.00	9
	Graduates	90.00	10.00	0.00	20
	Combined	89.66	10.34	0.00	29
Algebraic expressions	Employers	90.00	10.00	0.00	10
	Graduates	85.00	15.00	0.00	20
	Combined	86.67	13.33	0.00	30
Equations and Word Problems	Employers	80.00	20.00	0.00	10
	Graduates	70.00	30.00	0.00	20
	Combined	73.33	26.67	0.00	30
Determinants & Matrices	Employers	30.00	50.00	20.00	10
	Graduates	65.00	20.00	15.00	20
	Combined	53.33	30.00	16.67	30
Solutions to systems equations	Employers	70.00	30.00	0.00	10
	Graduates	75.00	20.00	5.00	20
	Combined	73.33	23.33	3.33	30
Factoring	Employers	50.00	40.00	10.00	10
	Graduates	60.00	35.00	5.00	20
	Combined	56.67	36.67	6.67	30
Fractions	Employers	90.00	10.00	0.00	10
	Graduates	73.68	26.32	0.00	19
	Combined	79.31	20.69	0.00	29
Quadratic Equations	Employers	20.00	70.00	10.00	10
	Graduates	75.00	15.00	10.00	20
	Combined	56.67	33.33	10.00	30

Table 84 (con't) Algebra (Items K.1. - K.14)
Electronics Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Complex & Imaginary Numbers	Employers	30.00	40.00	30.00	10
	Graduates	70.00	20.00	10.00	20
	Combined	56.67	26.67	16.67	30
Inequalities	Employers	30.00	50.00	20.00	10
	Graduates	60.00	35.00	5.00	20
	Combined	50.00	40.00	10.00	30
Ratio & Proportion	Employers	60.00	40.00	0.00	10
	Graduates	85.00	10.00	5.00	20
	Combined	76.67	20.00	3.33	30
Progressions	Employers	30.00	40.00	30.00	10
	Graduates	65.00	30.00	5.00	20
	Combined	53.33	33.33	13.33	30
Series; Expansions	Employers	20.00	50.00	30.00	10
	Graduates	60.00	25.00	15.00	20
	Combined	46.67	33.33	20.00	30

Table 85 Trigonometry (Items L.1. - L.6.)
Electronics Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Angles	Employers	80.00	10.00	10.00	10
	Graduates	75.00	20.00	5.00	20
	Combined	76.67	16.67	6.67	30
Trigonometric Functions	Employers	80.00	10.00	10.00	10
	Graduates	75.00	15.00	10.00	20
	Combined	76.67	13.33	10.00	30
Right Triangles	Employers	80.00	10.00	10.00	10
	Graduates	75.00	10.00	15.00	20
	Combined	76.67	10.00	13.33	30
Oblique Triangles	Employers	40.00	50.00	10.00	10
	Graduates	70.00	15.00	15.00	20
	Combined	60.00	26.67	13.33	30
Graphs of Trig Functions	Employers	30.00	60.00	10.00	10
	Graduates	65.00	20.00	15.00	20
	Combined	53.33	33.33	13.33	30
Inverse Trig Functions	Employers	10.00	80.00	10.00	10
	Graduates	55.00	30.00	15.00	20
	Combined	40.00	46.67	13.33	30

Table 86 Logarithns (Items M.1. - M.2.)
Electronics Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Exponential & Log Functions	Employers	50.00	40.00	10.00	10
	Graduates	80.00	10.00	10.00	20
	Combined	70.00	20.00	10.00	30
Logs of Trig Functions	Employers	40.00	40.00	20.00	10
	Graduates	65.00	25.00	10.00	20
	Combined	56.67	30.00	13.33	30

Table 87 Geometry - Figures and Formulas (Items N.1. - N.2.)
Electronics Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES Essential %	 Desirable %	 Not Needed %	Total N
Plane Geometry	Employers	30.00	50.00	20.00	10
	Graduates	50.00	35.00	15.00	20
	Combined	43.33	40.00	16.67	30
Solid Geometry	Employers	30.00	50.00	20.00	10
	Graduates	40.00	45.00	15.00	20
	Combined	36.67	46.67	16.67	30

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Table 88 Analytic Geometry (Items 0.1. - 0.4.)
Electronics Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Rectangular Coordinates	Employers	40.00	30.00	30.00	10
	Graduates	70.00	20.00	10.00	20
	Combined	60.00	23.33	16.67	30
Solving Equations Graphically	Employers	20.00	50.00	30.00	10
	Graduates	75.00	15.00	10.00	20
	Combined	56.67	26.67	16.67	30
Graphs of Log Functions	Employers	10.00	50.00	40.00	10
	Graduates	60.00	30.00	10.00	20
	Combined	43.33	36.67	20.00	30
Polar Coordinates	Employers	10.00	50.00	40.00	10
	Graduates	60.00	30.00	10.00	20
	Combined	43.33	36.67	20.00	30

Table 89 Calculus (Items P.1. - P.5.)
Electronics Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Differentiation	Employers	30.00	40.00	30.00	10
	Graduates	55.00	30.00	15.00	20
	Combined	46.67	33.33	20.00	30
Integration	Employers	20.00	50.00	30.00	10
	Graduates	45.00	40.00	15.00	20
	Combined	36.67	43.33	20.00	30
Differentiation of Functions	Employers	0.00	50.00	50.00	10
	Graduates	35.00	50.00	15.00	20
	Combined	23.33	50.00	26.67	30
Differential Equations	Employers	0.00	40.00	60.00	10
	Graduates	45.00	40.00	15.00	20
	Combined	30.00	40.00	30.00	30
Laplace Transforms	Employers	0.00	20.00	80.00	10
	Graduates	20.00	55.00	25.00	20
	Combined	13.33	43.33	43.33	30

Table 90 Statistics (Q.1. - Q.5.)
Electronics Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Probability	Employers	30.00	50.00	20.00	10
	Graduates	25.00	25.00	50.00	20
	Combined	26.67	33.33	40.00	30
Frequency Distributions	Employers	30.00	50.00	20.00	10
	Graduates	20.00	35.00	45.00	20
	Combined	23.33	40.00	36.67	30
Variability	Employers	30.00	50.00	20.00	10
	Graduates	20.00	35.00	45.00	20
	Combined	23.33	40.00	36.67	30
Sampling Theory	Employers	30.00	40.00	30.00	10
	Graduates	15.00	45.00	40.00	20
	Combined	20.00	43.33	36.67	30
Hypothesis Testing	Employers	20.00	30.00	50.00	10
	Graduates	20.00	40.00	40.00	20
	Combined	20.00	36.67	43.33	30

Appendix G

Industrial Engineering Technology Tables

Table 91 Mechanics (Items A.1. - A.5.)
Industrial Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Statics	Employers	0.00	66.67	33.33	3
	Graduates	25.00	75.00	0.00	4
	Combined	14.29	71.43	14.29	7
Fluid Mechanics	Employers	0.00	33.33	66.67	3
	Graduates	25.00	50.00	25.00	4
	Combined	14.29	42.86	42.86	7
Properties of Materials	Employers	0.00	66.67	33.33	3
	Graduates	25.00	75.00	0.00	4
	Combined	14.29	71.43	14.29	7
Strength of Materials	Employers	33.33	0.00	66.67	3
	Graduates	25.00	75.00	0.00	4
	Combined	28.57	42.86	28.57	7
Dynamics	Employers	33.33	33.33	33.33	3
	Graduates	75.00	25.00	0.00	4
	Combined	57.14	28.57	14.29	7

Table 92 Fundamentals of Electricity/Electronics (Items B.1. - B.7.)
Industrial Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Electric Fields	Employers	33.33	66.67	0.00	3
	Graduates	0.00	75.00	25.00	4
	Combined	14.29	71.43	14.29	7
Magnetic Fields	Employers	0.00	100.00	0.00	3
	Graduates	0.00	75.00	25.00	4
	Combined	0.00	85.71	14.29	7
D. C. Electricity	Employers	66.67	33.33	0.00	3
	Graduates	0.00	75.00	25.00	4
	Combined	28.57	57.14	14.29	7
A. C. Electricity	Employers	66.67	33.33	0.00	3
	Graduates	0.00	100.00	0.00	4
	Combined	28.57	71.43	0.00	7
Electronics	Employers	33.33	66.67	0.00	3
	Graduates	0.00	75.00	25.00	4
	Combined	14.29	71.43	14.29	7
Electrical Devices	Employers	100.00	0.00	0.00	3
	Graduates	25.00	75.00	0.00	4
	Combined	57.14	42.86	0.00	7
Electro-magnetics	Employers	33.33	33.33	33.33	3
	Graduates	0.00	75.00	25.00	4
	Combined	14.29	57.14	28.57	7

Table 93 Light (Items C.1. - C.4.)
Industrial Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES Essential %	Desirable %	Not Needed %	Total N
General Theory	Employers	33.33	33.33	33.33	3
	Graduates	0.00	75.00	25.00	4
	Combined	14.29	57.14	28.57	7
Geometrical Optics	Employers	33.33	33.33	33.33	3
	Graduates	0.00	25.00	75.00	4
	Combined	14.29	28.57	57.14	7
Physical Optics	Employers	33.33	33.33	33.33	3
	Graduates	0.00	25.00	75.00	4
	Combined	14.29	28.57	57.14	7
Spectral Analysis	Employers	33.33	33.33	33.33	3
	Graduates	0.00	25.00	75.00	4
	Combined	14.29	28.57	57.14	7

Table 94 Sound (Items D.1. - D.2.)
Industrial Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
General Theory	Employers	33.33	0.00	66.67	3
	Graduates	0.00	50.00	50.00	4
	Combined	14.29	28.57	57.14	7
Reception and Transmission	Employers	33.33	0.00	66.67	3
	Graduates	0.00	25.00	75.00	4
	Combined	14.29	14.29	71.43	7

Table 95 Heat (Items E.1. - E.3.)
Industrial Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
General Theory	Employers	66.67	33.33	0.00	3
	Graduates	25.00	75.00	0.00	4
	Combined	42.86	57.14	0.00	7
Heat Transfer	Employers	66.67	33.33	0.00	3
	Graduates	50.00	50.00	0.00	4
	Combined	57.14	42.86	0.00	7
Thermo-dynamics	Employers	33.33	66.67	0.00	3
	Graduates	25.00	50.00	25.00	4
	Combined	28.57	57.14	14.29	7

Table 96 Modern Physics (Items F.1. - F.3.)
Industrial Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Structure of Atom	Employers	33.33	0.00	66.67	3
	Graduates	0.00	75.00	25.00	4
	Combined	14.29	42.86	42.86	7
Relativity	Employers	33.33	0.00	66.67	3
	Graduates	0.00	25.00	75.00	4
	Combined	14.29	14.29	71.43	7
Fission, Fusion, Radio-Activity	Employers	33.33	0.00	66.67	3
	Graduates	0.00	25.00	75.00	4
	Combined	14.29	14.29	71.43	7

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Table 97 Chemistry (Items G.1. - G.5.)
Industrial Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
General Chemistry	Employers	33.33	66.67	0.00	3
	Graduates	0.00	100.00	0.00	4
	Combined	14.29	85.71	0.00	7
Qualitative Chemistry	Employers	33.33	33.33	33.33	3
	Graduates	0.00	25.00	75.00	4
	Combined	14.29	28.57	57.14	7
Quantitative Chemistry	Employers	33.33	66.67	0.00	3
	Graduates	0.00	0.00	100.00	4
	Combined	14.29	28.57	57.14	7
Physical Chemistry	Employers	66.67	33.33	0.00	3
	Graduates	0.00	25.00	75.00	4
	Combined	28.57	28.57	42.86	7
Organic Chemistry	Employers	33.33	33.33	33.33	3
	Graduates	0.00	25.00	75.00	4
	Combined	14.29	28.57	57.14	7

Table 98 Biology (Items H.1. - H.6.)
Industrial Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
General Biology	Employers	33.33	33.33	33.33	3
	Graduates	0.00	25.00	75.00	4
	Combined	14.29	28.57	57.14	7
Micro-biology	Employers	33.33	33.33	33.33	3
	Graduates	0.00	25.00	75.00	4
	Combined	14.29	28.57	57.14	7
Ecology	Employers	33.33	33.33	33.33	3
	Graduates	0.00	25.00	75.00	4
	Combined	14.29	28.57	57.14	7
Botany	Employers	0.00	66.67	33.33	3
	Graduates	0.00	0.00	100.00	4
	Combined	0.00	28.57	71.43	7
Zoology	Employers	0.00	66.67	33.33	3
	Graduates	0.00	0.00	100.00	4
	Combined	0.00	28.57	71.43	7
Genetics	Employers	0.00	66.67	33.33	3
	Graduates	0.00	0.00	100.00	4
	Combined	0.00	28.57	71.43	7

Table 99 Geology (Items I.1. - I.5.)
Industrial Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Physical Geology	Employers	33.33	0.00	66.67	3
	Graduates	0.00	25.00	75.00	4
	Combined	14.29	14.29	71.43	7
Economic Geology	Employers	0.00	33.33	66.67	3
	Graduates	0.00	0.00	100.00	4
	Combined	0.00	14.29	85.71	7
Structural Geology	Employers	0.00	33.33	66.67	3
	Graduates	0.00	0.00	100.00	4
	Combined	0.00	14.29	85.71	7
Geophysics	Employers	0.00	33.33	66.67	3
	Graduates	0.00	0.00	100.00	4
	Combined	0.00	14.29	85.71	7
Hydrology	Employers	0.00	33.33	66.67	3
	Graduates	25.00	0.00	75.00	4
	Combined	14.29	14.29	71.43	7

Table 100 Data Processing (Items J.1. - J.2.)
Industrial Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES Essential %	 Desirable %	 Not Needed %	Total N
FORTRAN	Employers	50.00	0.00	50.00	2
	Graduates	0.00	75.00	25.00	4
	Combined	16.67	50.00	33.33	6
BASIC	Employers	50.00	0.00	50.00	2
	Graduates	0.00	75.00	25.00	4
	Combined	16.67	50.00	33.33	6

Table 101 Algebra (Items K.1. - K.14.)
Industrial Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Exponents and Radicals	Employers	100.00	0.00	0.00	3
	Graduates	50.00	50.00	0.00	4
	Combined	71.43	28.57	0.00	7
Scientific Notation	Employers	100.00	0.00	0.00	3
	Graduates	75.00	25.00	0.00	4
	Combined	85.71	14.29	0.00	7
Algebraic Expressions	Employers	100.00	0.00	0.00	3
	Graduates	100.00	0.00	0.00	4
	Combined	100.00	0.00	0.00	7
Equations and Word Problems	Employers	100.00	0.00	0.00	3
	Graduates	100.00	0.00	0.00	4
	Combined	100.00	0.00	0.00	7
Determinants & Matrices	Employers	66.67	33.33	0.00	3
	Graduates	25.00	25.00	50.00	4
	Combined	42.86	28.57	28.57	7
Solutions to systems equations	Employers	100.00	0.00	0.00	3
	Graduates	75.00	25.00	0.00	4
	Combined	85.71	14.29	0.00	7
Factoring	Employers	100.00	0.00	0.00	3
	Graduates	25.00	50.00	25.00	4
	Combined	57.14	28.57	14.29	7
Fractions	Employers	100.00	0.00	0.00	3
	Graduates	100.00	0.00	0.00	4
	Combined	100.00	0.00	0.00	7
Quadratic Equations	Employers	100.00	0.00	0.00	3
	Graduates	25.00	50.00	25.00	4
	Combined	57.14	28.57	14.29	7

Table 101 (con't) Algebra (Items K.1. - K.14.)
Industrial Engineering Technology

ITEM	GROUP	Essential %	Desirable %	Not Needed %	Total N
Complex & Imaginary Numbers	Employers	66.67	33.33	0.00	3
	Graduates	25.00	50.00	25.00	4
	Combined	42.86	42.86	14.29	7
Inequalities	Employers	66.67	33.33	0.00	3
	Graduates	25.00	75.00	0.00	4
	Combined	42.86	57.14	0.00	7
Ratio & Proportion	Employers	100.00	0.00	0.00	3
	Graduates	100.00	0.00	0.00	4
	Combined	100.00	0.00	0.00	7
Progressions	Employers	100.00	0.00	0.00	3
	Graduates	25.00	75.00	0.00	4
	Combined	57.14	42.86	0.00	7
Series; Expansions	Employers	66.67	33.33	0.00	3
	Graduates	25.00	25.00	50.00	4
	Combined	42.86	28.57	28.57	7

Table 102 Trigonometry (Items L.1. - L.6.)
Industrial Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Angles	Employers	100.00	0.00	0.00	3
	Graduates	100.00	0.00	0.00	4
	Combined	100.00	0.00	0.00	7
Trigonometric Functions	Employers	100.00	0.00	0.00	3
	Graduates	100.00	0.00	0.00	4
	Combined	100.00	0.00	0.00	7
Right Triangles	Empoyers	100.00	0.00	0.00	3
	Graduates	75.00	25.00	0.00	4
	Combined	85.71	14.29	0.00	7
Oblique Triangles	Employers	100.00	0.00	0.00	3
	Graduates	100.00	0.00	0.00	4
	Combined	100.00	0.00	0.00	7
Graphs of Trig Functions	Employers	100.00	0.00	0.00	3
	Graduates	25.00	50.00	25.00	4
	Combined	57.14	28.57	14.29	7
Inverse Trig Functions	Employers	100.00	0.00	0.00	3
	Graduates	25.00	50.00	25.00	4
	Combined	57.14	28.57	14.29	7

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Table 103 Logarithms (Items M.1. - M.2.)
Industrial Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Exponential & Log Functions	Employers	100.00	0.00	0.00	3
	Graduates	25.00	75.00	0.00	4
	Combined	57.14	42.86	0.00	7
Logs of Trig Functions	Employers	100.00	0.00	0.00	3
	Graduates	25.00	50.00	25.00	4
	Combined	57.14	28.57	14.29	7

Table 104 Geometry - Figures and Formulas (Items N.1. - N.2.)
Industrial Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Plane Geometry	Employers	100.00	0.00	0.00	3
	Graduates	50.00	50.00	0.00	4
	Combined	71.43	28.57	0.00	7
Solid Geometry	Employers	66.67	33.33	0.00	3
	Graduates	50.00	50.00	0.00	4
	Combined	57.14	42.86	0.00	7

Table 105 Analytic Geometry (Items 0.1 - 0.4.)
Industrial Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Rectangular Coordinates	Employers	66.67	33.33	0.00	3
	Graduates	50.00	25.00	25.00	4
	Combined	57.14	28.57	14.29	7
Solving Equations Graphically	Employers	66.67	33.33	0.00	3
	Graduates	25.00	25.00	50.00	4
	Combined	42.86	28.57	28.57	7
Graphs of Log Functions	Employers	66.67	33.33	0.00	3
	Graduates	25.00	25.00	50.00	4
	Combined	42.86	28.57	28.57	7
Polar Coordinates	Employers	66.67	33.33	0.00	3
	Graduates	25.00	25.00	50.00	4
	Combined	42.86	28.57	28.57	7

Table 106 Calculus (Items P.1. - P.5.)
Industrial Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Differentiation	Employers	66.67	0.00	33.33	3
	Graduates	25.00	50.00	25.00	4
	Combined	42.86	28.57	28.57	7
Integration	Employers	66.67	0.00	33.33	3
	Graduates	25.00	50.00	25.00	4
	Combined	42.86	28.57	28.57	7
Differentiation of Functions	Employers	66.67	0.00	33.33	3
	Graduates	25.00	50.00	25.00	4
	Combined	42.86	28.57	28.57	7
Differential Equations	Employers	66.67	0.00	33.33	3
	Graduates	25.00	50.00	25.00	4
	Combined	42.86	28.57	28.57	7
Laplace Transforms	Employers	66.67	0.00	33.33	3
	Graduates	25.00	25.00	50.00	4
	Combined	42.86	14.29	42.86	7

Table 107 Statistics (Items Q.1. - Q.5.)
Industrial Engineering Technology

ITEM	GROUP	RESPONSE CATEGORIES			Total N
		Essential %	Desirable %	Not Needed %	
Probability	Employers	100.00	0.00	0.00	3
	Graduates	25.00	50.00	25.00	4
	Combined	57.14	28.57	14.29	7
Frequency Distributions	Employers	100.00	0.00	0.00	3
	Graduates	25.00	50.00	25.00	4
	Combined	57.14	28.57	14.29	7
Variability	Employers	100.00	0.00	0.00	3
	Graduates	25.00	50.00	25.00	4
	Combined	57.14	28.57	14.29	7
Sampling Theory	Employers	100.00	0.00	0.00	3
	Graduates	25.00	75.00	0.00	4
	Combined	57.14	42.86	0.00	7
Hypothesis Testing	Employers	66.67	33.33	0.00	3
	Graduates	25.00	50.00	25.00	4
	Combined	42.86	42.86	14.29	7

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